Final Report: 2003-2004 Mammalian Inventories for Three National Parks in the Southern Colorado Plateau Network

Bandelier National Monument

Chaco Culture National Historic Park

El Malpais National Monument

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Submitted to: Anne Cully and Lisa Thomas, National Park Service, Southern Colorado Plateau Network, Flagstaff, AZ

Prepared by: Keith Geluso and Michael A. Bogan, U.S. Geological Survey, Fort Collins Science Center, Arid Lands Field Station, Department of Biology, University of New Mexico, Albuquerque, NM 87131

ABSTRACT

In an effort to gather valuable biological information, the National Park Service initiated a nationwide program to inventory vascular plants and vertebrates on lands administered by National Park Service. In 2003, biologists from the United States Geological Survey, Fort Collins Science Center, Arid Lands Field Station, continued as cooperators on this effort at three parks in the Southern Colorado Plateau Network: Bandelier National Monument, Chaco Culture National Historical Site, and El Malpais National Monument. Our primary objective was to attempt to document the occurrence of at least 90% of the mammalian species expected to occur at each park via a two-year field inventory and examination of existing pertinent records. Overall, we documented 70 species of mammals at the three parks. We captured or observed sign of 2312 mammals, including 2 species of insectivores, 13 species of bats, 4 species of lagomorphs, 36 species of rodents, 11 species of carnivores, and 4 species of ungulates. At Bandelier National Monument, we documented 50 species of mammals. We captured or observed sign of 996 individuals, including 2 species of insectivores, 12 species of bats, 3 species of lagomorphs, 22 species of rodents, 9 species of carnivores, and 2 species of ungulates. At present, documentation exists for 59 extant and 2 extirpated species at the park. Currently, the overall level of documentation of mammals is 89%. At Chaco Culture National Historical Park, we documented 33 species of mammals. We captured or observed sign of 579 individuals, including 3 species of bats, 2 species of lagomorphs, 19 species of rodents, 6 species of carnivores, and 3 species of ungulates. At present, documentation exists for 50 extant and 1 historic species at the park. Currently, the overall level of documentation of mammals is 94%. At El Malpais National Monument, we documented 45 species of mammals. We captured or

observed sign of 737 individuals, including 12 species of bats, 2 species of lagomorphs, 20 species of rodents, 8 species of carnivores, and 3 species of ungulates. Currently, documentation exists for 53 extant species of mammals at the park, and the overall level of documentation is 90%. Efforts to document mammalian species on these three parks should be viewed as a work in progress, although good progress was made during our efforts. Compared to our previous efforts on other parks, we had much higher levels of overall documentation, which likely reflects both talents of field mammalogists as well as earlier work on mammals at these parks.

Key words: Bandelier National Monument, Chaco Culture National Historical Park, El Malpais National Monument, mammal, inventory

TABLE OF CONTENTS

TABLE OF TABLES

INTRODUCTION

Historically, the Colorado Plateau has been the subject of many geological and biological explorations. J. W. Powell explored and mapped the canyon country of the Colorado River in 1869 (Powell [reprinted] 1961). C. H. Merriam, V. Bailey, M. Cary and other employees of the Bureau of Biological Survey conducted biological explorations of the area in the late 1800's. In recent times, researchers such as S. D. Durrant (1952), Durrant and Robinson (1962), D. M. Armstrong (1972), J. S. Findley et al. (1975), D. F. Hoffmeister (1986) and J. Fitzgerald et al. (1994) have made considerable contributions to our understanding of the fauna of the Colorado Plateau. Despite earlier efforts, biological details on many regions of the plateau have remained insufficiently explored.

In an effort to gather valuable biological information, the National Park Service (NPS) initiated a nationwide program to inventory vascular plants and vertebrates on NPS lands (Stuart 2000). The U.S. Geological Survey, Fort Collins Science Center, Arid Lands Field Station became cooperators on this effort in 2001 when we began mammalian inventories on five parks within the NPS Southern Colorado Plateau Network: Aztec Ruins National Monument (AZRU), El Morro National Monument (ELMO), Petroglyph National Monument (PETR), Salinas Pueblo National Monument (SAPU), and Yucca House National Monument (YUHO). Existing baseline data on mammalian occurrences in these parks varied from very sparse to moderate, with little information available for most parks. In most cases information was insufficient to assess the status of species of local concern. A final report on inventory efforts on these five parks was submitted in February 2004 (Bogan et al. 2004).

In 2003, biologists from the Arid Lands Field Station began work on three additional parks in the SCPN: Bandelier National Monument (BAND), Chaco Culture National Historical Park (CHCU), and El Malpais National Monument (ELMA). The primary emphasis at these three parks was on non-volant mammals, as personnel from the Field Station had worked earlier on bats at all three parks (Bogan et al. 1998, Valdez et al. 2002a, b). This report details work conducted on these three parks during 2003 and 2004.

Objectives

The primary objective of our inventories was to attempt to document the occurrence of at least 90% of the mammalian species expected to occur at each park via a two-year field inventory and examination of existing pertinent records. Secondary objectives included describing the distribution and abundance of species of special concern (e.g., Threatened and Endangered species, exotics, and other species of special management interest), providing baseline information necessary for the development of a monitoring strategy, and assisting in the development of a coordinated network data management effort resulting in biological resource information being accessible to resource managers, scientists, and the public. Data from the present project will directly contribute to development of a long-term monitoring curriculum for each park.

Study area

The Colorado Plateau is a geologically and topographically distinct region with numerous plateaus and highlands that, strictly speaking, are drained by the Colorado River and its numerous tributaries. It is situated between the arid Great Basin to the west and the montane

forests of the Rocky Mountains to the east and covers approximately 337,000 km^2 (130,000 $mi^{2)}$. From the perspective of the National Park Service, it extends from southwestern Wyoming, through much of eastern Utah, and includes parts of western Colorado, northern Arizona, and northwestern New Mexico (Stuart 2000).

The NPS units included in the Southern Colorado Plateau Network are in Arizona, Colorado, New Mexico, and Utah. They range in size from 404,700 ha (more than a million acres) (Grand Canyon National Park-GRCA and Glen Canyon National Recreation Area) to 14.8 ha (34 acres) (YUHO), and encompass a diverse array of landforms, elevation ranges, geologic substrates, vegetation types, and wildlife habitats. Most are within the Colorado Plateau region, and are dominated by Colorado Plateau shrubland, grassland, and piñon-juniper woodland. However, peripheral parks and elevation extremes are allied with the Mogollon Highlands, Great Plains, Sonoran Desert, Chihuahuan Desert, Middle Rio Grande Basin, and Southern Rocky Mountain regions.

The climate of the Colorado Plateau is characterized by periods of drought and irregular precipitation, relatively warm to hot growing seasons, and long winters with sustained periods of freezing temperatures. Winters are dominated by Pacific region storm patterns, while the southern portions of the Plateau are dominated by monsoonal moisture from the Gulf of Mexico. Orographic effects control local climates on the central portions of the Colorado Plateau. Evapotranspiration rates are extremely high for a temperate region, resulting from hot summers and extremely low precipitation (100-250 mm/yr or 4-10 in/yr in most locations; Stuart 2000).

Vegetation on much of the plateau is characterized by low, open woodlands of drought-adapted conifers at intermediate elevations, and extensive areas of drought-tolerant shrubs and grasses at lower elevations. At the highest elevations, significant communities of ponderosa

pine, mixed conifer, and subalpine forests occur, especially at GRCA and BAND. Due to freezing temperatures in the winter, large succulents that characterize subtropical and warm-temperate regions are lacking.

Although the Colorado Plateau has been a distinct geological region for much of the Mesozoic and Cenozoic, vertebrate biota is in many ways impoverished compared to surrounding areas. This may result both from history, because of the relatively rapid rise of the region combined with increased erosion and cooling temperatures since the Miocene, and from harsh climate. Among the mammals, Stephen's woodrat, arguably may be a mammalian endemic to the Colorado Plateau (Hoffmeister 1986).

Serious gaps exist in our understanding of some taxonomic groups on the Colorado Plateau. In particular, relatively little is known about the status and distribution of bats, small mammals, reptiles (especially snakes), amphibians, indigenous annual plants, and exotic plants. Even available data on the better-known large mammals, birds and perennial plants is uneven in quality. Good biological inventory data and reliable species lists are critical to understanding the natural resources in each of the network park units, and will provide useful information for a wide range of resource management issues.

Background on Bandelier National Monument (BAND)

Bandelier National Monument is located in the Jemez Mountains of north-central New Mexico. The Presidential proclamation that created Bandelier in 1916 (No. 1322; stat. 1764:1916) stated that "... certain prehistoric aboriginal ruins… are of unusual ethnologic, scientific, and educational interest, and it appears that the public interests would be promoted by preserving these relics of a vanished people, with as much land as may be necessary for the

proper protection thereof...." The significance of Bandelier lies in its superb combination of cultural, natural, and wilderness values. To recognize the wilderness values, President Ford signed legislation in October 1976, creating a 9423 ha (23,267 acres) Bandelier Wilderness (Public Law 94-567). Ninety percent of the park is managed as wilderness, and more than half of its trails (Frijoles Cañon and Bandelier Backcountry) are part of the National Trail System. Bandelier's ecosystems and their biogeophysical elements are highly altered, poorly understood, and possibly unstable (Stuart 2000). Loss of naturally functioning ecosystems as a result of historic grazing and fire suppression are causing accelerated loss of soils and cultural resource values and material remains, catastrophic fires, and unnatural changes in plant and animal abundance and distribution.

There has not been a broad, systematic survey of the mammal fauna of BAND. Guthrie and Large (1980) summarized data on distribution and frequency of mammals within BAND, drawing primarily on sightings by park personnel and visitors prior to September 1979. Individual research studies include an extensive survey of bats, which provided data on the occurrence and biology of 15 bat species in the Bandelier area (Bogan et al. 1998). Stuart (2000) estimated the documentation level of mammals at BAND was 80% and the number of species to be 44.

Background on Chaco Culture National Historic Park (CHCU)

Chaco Culture National Historical Park is located in northwestern New Mexico. The park and a system of Chaco Culture Archaeological Protection Sites (Chaco Protection Sites) were established for purposes of recognizing and preserving unique archaeological resources within Chaco Canyon, the San Juan Basin, and surrounding area. The park is listed in the

National Register of Historic Places, and was also designated an UNESCO World Heritage Site in 1987. The role of the park in conserving regional biodiversity will become more important as park vegetation continues to recover from earlier grazing activities and as land use pressure mounts on the surrounding region. Land within the original national monument was fenced between 1935 and 1948. Today, the park likely represents the largest ungrazed grassland resource in northwestern New Mexico. Non-native tamarisk (*Tamarix* spp.) is common throughout Chaco Wash. Cheatgrass (*Bromus tectorum*) has invaded several thousand hectares within the park. Past research at Chaco Canyon included studies of plant remains from archeological sites and early Holocene packrat middens, as well as some work on birds, reptiles, and limited work on mammals.

Individual research projects pertaining to mammals at CHCU include Cully (1981), which analyzed distribution and abundance of small mammals from trapping data in four habitats; Jones (1972), which discussed small mammal trapping data; and Valdez et al. (2002a), which conducted an intensive survey of bats. Stuart (2000) estimated completeness of biological inventories for mammals at CHCU was 80% with an estimated 44 species thought to occur.

Background on El Malpais National Monument (ELMA)

El Malpais National Monument, located in west-central New Mexico, was established to preserve the nationally significant Grants Lava Flow, the Las Ventanas Chacoan Archeological Site, and other significant natural and cultural resources. ELMA preserves and protects natural and cultural resources of the unique lava fields and associated features. It also perpetuates this ecosystem for the benefit of present and future generations, for traditional cultural uses, and for long-term scientific inquiry. Inventory of plant and animal species on the monument will

provide information for management decisions on resource issues, including the occurrence of rare, unknown, and endemic species associated with the lava flows. Useful information on the natural history of the park is included in Mabery (1997). Of the three parks, ELMA is probably the least studied for mammals, although Hooper (1941) provided important information on mammals of the lava fields and some mammal work was done in connections with surveys conducted by Lightfoot et al. (1994). Valdez et al. (2002b) documented the occurrence of bats at ELMA and provided data on relative abundance, reproduction, seasonal activity, diet, and ectoparasites. Bats were captured with mist-nets and occurrence and activity were monitored with ultrasonic detectors (ANABAT). Stuart (2000) estimated completeness of biological inventories for mammals at ELMA was 80% with an estimated 48 species thought to occur on the park.

METHODS

We initially prepared a list of mammals for each park that included all species that might occur in or near each park. Primary references for these lists were Bogan et al. (1998), Cully (1981), Findley et al. (1975), Guthrie and Large (1980), Hall (1981), Hooper (1941), and Valdez et al. (2002a, b). Species on each list were initially designated as unconfirmed, probably present, or present. Our lists indicated cases in which documentation relied on voucher specimens in these references. Throughout our 2003 and 2004 field seasons, we continually updated these lists based on our observations. Finally, we critically assessed the likelihood of each species occurring after viewing and trapping all major habitats at each park. Our final designations on mammal lists ("Master Lists") are as follows: (1) "unconfirmed" are those species that are unlikely to occur based on habitat availability but are known from the region or are those species

extirpated from the region without prior documentation at parks; (2) “historic” are those species that have occurred in parks in the past and have reliable documentation of their occurrence; (3) “probably present” are those species that most likely occur on the park but have gone undetected due to low abundances (e.g., some small carnivores) or lack of appropriate trapping methods (e.g., pitfall traps for shrews); and (4) “present” are those species that have reliable documentation such as voucher specimens, reliable sighting, photographs, or observations of diagnostic sign. Using our final updated lists allowed us to assess our progress toward documenting 90% of likely species occurring on each given park.

In 2003 and 2004, we primarily used targeted searches and trapping to attempt to document as many species as possible and focused on the most speciose groups with the greatest promise of increasing our level of documentation. These groups generally included carnivores and rodents. Our inventory efforts included trapping, mist-netting, track and scat surveys, and spotlighting. Other mammals, such as ungulates, rabbits, and squirrels, generally were documented opportunistically while conducting our other types of surveys.

For each individual captured in traps and mist nets, we recorded species, age, sex, and reproductive condition. Except for a few individuals kept as voucher specimens, each individual was released unharmed at the site of capture. Voucher material was kept for most species of rodents that were previously undocumented or lacked reliable documentation. Additionally, some individuals also were retained for identification purposes. We feel that collection of voucher material is extremely important for all inventory work and provides the most definitive and unequivocal evidence that a species has occurred in an area. The future use of these vouchers cannot be understated, especially with recent advances in molecular tools. For example, voucher materials from specific sites are needed to determine identification of taxa that

are split into multiple species, especially where newly described species are sympatric. Voucher material also is fundamentally important because distributions of mammals are not static and are continually in flux. Ranges of mammals can shift as result of both climatic and anthropogenic changes to the environment. Additionally, voucher material is important because of the potential misidentifications of closely related species, such as those in the genus *Peromsycus* (see Geluso 2004 and Geluso and Geluso 2004).

All trapping and observation locations were recorded using Global Positioning System (GPS) units set to UTM in either datum NAD27 or NAD83, in accordance with NPS protocol. While in the field, we recorded data onto datasheets and summarized our findings in written field notes. After returning from field efforts at parks, these data were then entered into a relational database (Access) provided by the Southern Colorado Plateau Network.

Capture and handling of animals was performed in accordance with written protocol approved by the USGS Fort Collins Science Center, Animal Care and Use Committee. Voucher specimens (skins and skeletal material) are housed in the USGS Biological Survey collection at the Museum of Southwestern Biology, University of New Mexico (UNM). For almost all vouchers collected during this project, tissues samples of heart, kidneys and liver were preserved in liquid nitrogen and deposited in the Division of Genomic Resources at UNM. Names, both common and scientific, follow Baker et al. (2003).

Small terrestrial mammal inventories

Rodents and other small terrestrial mammals were inventoried using Sherman live traps, Tomahawk live traps, and snap traps arranged in traplines (Wilson et al. 1996). Traplines typically consisted of 40-80 Sherman traps placed at 10-15 m intervals. Traps were baited with

old fashioned dry oatmeal (not “quick oats” or “instant oats”) and generally left open overnight. In some cases, traps were left open during daylight hours to catch diurnal species such as squirrels. In 2003, some Sherman live traps were baited with peanut butter and oatmeal, folded in waxpaper; these peanut butter packets were hung just inside the back door. This technique was employed to examine if a bait containing peanut butter in Sherman live traps will increase trap success and/or increase the number of species captured (e.g., shrews). At each park, study sites were selected so that each major type of habitat within a given park was sampled. Effort was reported as number of trap-nights, the summation of total number of traps deployed each night.

Bat inventories

Because of previous studies on bats on these parks (Bogan et al. 1998, Valdez et al. 2002a, b), minimal effort was spent on additional inventory of bats. In a few cases, mist nets were deployed across and around bodies of water in order to capture bats coming in to drink or feed on insects flying over the water (Kunz and Kurta 1988). Lengths of nets ranged from 6-20 m (18-60 ft) and number of nets varied depending on the area of water. Mist nets were set up shortly before sunset and tended for several hours until activity declined. This method is especially effective when sources of water are limited in the landscape, thus concentrating bats in a relatively small area where they are more susceptible to capture. Effort was recorded as net-nights, the summation of the number of mist nets deployed each night.

Carnivore inventories

To document carnivores, we conducted track-scat surveys, live-trapping, and spotlighting. Track-scat surveys entailed searching on foot in areas likely used by carnivores and that would show evidence of these species, such as around water sources, in canyon bottoms, in sandy soils, and around areas where humans leave refuse (e.g. campgrounds and housing areas). Tracks, scat, carcasses, and animals were documented with location coordinates. Occasionally, we attempted to capture small carnivores using Tomahawk live-traps baited with a variety of odoriferous baits. We used a handheld spotlight from vehicles to search for and view animals at night. Effort for carnivore inventories was quantified as distance walked (km), hours driven with spotlights, or number of trap-nights.

Opportunistic observations

During our field efforts, many mammals were observed while driving, walking, or setting and checking traplines during daylight hours. These observations also were documented on datasheets, and locations were determined with GPS's. We always recorded these data for uncommon or unusual species; however, for some abundant species, such as elk at BAND, we only took these data occasionally. Opportunistic observations were the predominant means of documenting ungulates, but many other species also were documented in this manner such as squirrels and rabbits. We also recorded observations of diagnostic sign of animals such as the conspicuous workings of beavers or middens of red squirrels. Lastly and where possible, we examined park observation files for records of mammals. In cases where the species is distinct and unlikely to be confused with another, we generally accepted observations, especially if there

were multiple occurrences. In other cases where a species might likely be confused with another, or where there was only a single observation, we usually discounted the observation.

Data analyses

Number of species documented (species richness) and relative abundance of species (percent of all individuals detected) were calculated for each park. We also provided a summary of effort for each park including person-days, trap-nights, net-nights, hours spotlighting, and distance walked for carnivores, as appropriate. Capture, observation, GPS, and habitat data were entered into an Access database provided by the SCPN. We also determined our progress toward the overall level of documentation of mammals by dividing number of species currently documented at each park by the total number of species probable (i.e., not the total number of species possible, which includes extirpated, historical, and unconfirmed species).

RESULTS

Overall Results

During the 2003 and 2004 field seasons, we worked 276 person-days, accrued 9764 trap-nights, accumulated 26 net-nights, drove 15.5 hours spotlighting, and walked 373 km for carnivores and diurnal mammals towards fulfillment of our objective (Table 1). Overall, we documented 70 species of mammals at the three parks (Table 2). We captured or observed sign of 2312 mammals, including 2 species of insectivores, 13 species of bats, 4 species of lagomorphs, 36 species of rodents, 11 species of carnivores, and 4 species of ungulates (Table 2). The most frequently encountered mammal was the deer mouse (*Peromyscus maniculatus*, 417 captures), which occurs at all three parks (Table 2). A total of three individual shrews were

captured during our two-year efforts on the parks (Table 2); the most frequently captured species was the montane shrew (*Sorex monticolus*). The most frequently netted bat was the silver-haired bat (*Lasionycteris noctivagans*, Table 2), which accounted for 24% of all observations of bats. The most frequently observed lagomorph was the desert cottontail (*Sylvilagus audubonii*, Table 2), which accounted for 40% of all observations of lagomorphs. The ubiquitous deer mouse (*P. maniculatus*) was the most frequently observed rodent, accounting for 28% of all observations of rodents. The most frequently observed carnivore was the coyote (*Canis latrans*, Table 2), which accounted for 36% of all observations of carnivores. The most frequently observed ungulate was the elk (*Cervus canadensis*, Table 2), which accounted for 59% of all sightings of ungulates. The total number and percent relative abundance of mammals at the three parks (Table 3) shows that the deer mouse (*P. maniculatus*) had highest relative abundance of all mammals during our survey, followed by the piñon mouse (*P. truei*), and elk (*C. canadensis*).

Our "Master Lists" of mammals that occur at BAND, CHCU, and ELMA (Tables 4, 5, and 6) reflect our current understanding of mammals at the parks and provide specific reference on species status at each park. Following our field efforts and examination of pertinent references, our level of documentation was 89% at BAND, 94% at CHCU, and 90% at ELMA (Tables 7, 8, and 9). We also provide tables concerning selected attributes of mammals for use in NP-SPECIES database, including the abundance, residency, and nativity of each species at each park (Tables 10, 11, and 12). Lastly in Appendix 1, we list personnel that assisted with mammalian inventories at the three parks during 2003 and 2004, along with titles and contact information.

Specific details concerning each park during our inventory are presented in sections below. Within each section, we begin with overall results for that park, followed by specific detail concerning each mammalian order.

Bandelier National Monument

In 2003 and 2004, we worked 132 person-days, accrued 3682 trap-nights, accumulated 13 net-nights, drove 4 hours spotlighting, and walked 178 km for carnivores and diurnal mammals towards fulfillment of our objective (Table 1). Overall, we documented 50 species of mammals at BAND (Table 2). We captured or observed sign of 996 mammals, including 2 species of insectivores, 12 species of bats, 3 species of lagomorphs, 22 species of rodents, 9 species of carnivores, and 2 species of ungulates (Table 2).

At present, we have documentation of 59 extant and 2 extirpated species of mammals at BAND (Table 4). This number far exceeds the predicted species richness of 44 (Stuart 2000) and reflects the diversity of habitats available for mammals at the park. Currently, the overall level of documentation for BAND is 89%, with levels of documentation ranging from 33 to 100% for specific mammalian orders (Table 7). At present, insectivores have the lowest documentation at 33% and bats, lagomorphs, and ungulates have documentation of 100% (Table 7). We determined that the previous level of documentation of mammals at BAND was 85% (Table 7). This relatively high level of documentation is a reflection of information gathered from previous unpublished reports by Bogan et al. (1998) and Guthrie and Large (1980). Without these prior investigations, documentation of mammals would be almost nonexistent for BAND. During our field efforts, we confirmed many small mammals at BAND reported by

Guthrie and Large (1980) and secured voucher material of 2 species of insectivores, 2 species of bats, 1 species of lagomorph, and 18 species of rodents.

Insectivores.—To date, two species of shrews (*S. monticolus* and *S. palustris*) have been positively confirmed to occur at BAND. However, we suspect that up to six species of shrews inhabit the park. These additional species probably occur at BAND because they have been captured in other regions of the Jemez Mountains (see Findley et al. 1975 and Kirkland and Findley 1996) in habitats that occur within park boundaries. Recently, we have received shipments of preserved shrews (and other small mammals) that were collected in insect pitfall traps associated with another project at the park. We have yet to prepare these specimens in a manner that will allow us to identify these individuals to species. This collection certainly will improve the knowledge of soricids at BAND.

During the summer of 2004, we trapped for many nights in Cañon de los Frijoles in search of the water shrew. On 22 June, we captured an adult male along Rio de los Frijoles in a Sherman live trap. This individual represents a new park record and only the sixth individual of *S. palustris* known from the Jemez Mountains. Additionally, our capture may represent the first capture of this shrew in the Jemez Mountains since the early 1970's. Our findings suggest that *S. palustris* is more widespread in the area, although it is relatively uncommon.

Bats.—At BAND, 15 species of bats are known to occur (Table 4). Guthrie and Large (1980) originally reported 12 species at the park, but Bogan et al. (1998) discovered an additional 3 species (*Pipistrellus hesperus*, *Euderma maculatum*, and *Nyctinomops macrotis*). During our present inventory, we captured or heard the audible echolocation calls of 12 species of bats (Table 4). Of the 15 species known to occur at BAND, we feel that the spotted bat (*E. maculatum*) and big free-tailed bat (*N. macrotis*) are of special interest to BAND and the state.

These species have a relatively patchy distribution across their entire range and are captured infrequently in mist nets. Much detailed information concerning the ecology and natural history of these species is yet to be determined. Radio-tracking studies have located roosting sites of both species in the Jemez Mountains (Bogan et al. 1998), and diet analyses of *N. macrotis* from the Jemez showed that this species consumed an unusual variety of arthropods (Sparks and Valdez 2003). During our present investigation, we heard the distinctive and diagnostic audible calls of both species almost nightly at the Juniper Campground. At higher elevations, we generally heard only calls of spotted bats.

Lagomorphs.—Four species of lagomorphs reside at BAND (Table 4). Guthrie and Large (1980) originally documented only three species, including the desert cottontail (*Sylvilagus audubonii*), mountain cottontail (*S. nuttallii*), and black-tailed jackrabbit (*Lepus californicus*). During our inventory, we observed *S. audubonii* and *S. nuttallii* but not *L. californicus*. In addition, we also discovered the American pika (*Ochotona princeps*) at higher elevations on Cerro Grande. On 30 June 2004, we observed a minimum of 3 adults and 1 sub-adult on a felsameer slope southwest of Cerro Grande. In 2003, we only heard pikas and observed their fecal pellets on this same slope. In the Jemez Mountains, pikas previously have been documented from the Jemez Mountains at Pajarito Mountain, Goat Peak, and Los Alamos ski area, SE edge Valle Grande, 1.3 km S Pajarito Mountain, Chicoma Mountain, and Redondo Peak (Swickard et al. 1971, Findley et al. 1975). Swickard et al. (1971) also reported the diagnostic droppings of pika in horizontal crevices at the edge of the cliffs overlooking the northwest branch of Frijoles Canyon. These authors reported that pikas inhabited almost all suitable rockslides in the mountain range above 2589 m (9150 ft). Thus, these data suggest that pika have always occurred on BAND. In light of recent data from the Great Basin concerning

extirpation among isolated populations of pika (Beever et al. 2003), we propose that pika may serve as an important indicator for future long-term monitoring at BAND by the NPS. Beever et al. (2003) reported that biogeographic, climatic, and human influence all appear to be plausible causes of recent extirpation of pikas and the synergistic influences of these factors may magnify possible threats. These authors point out that losses of pika populations can occur without apparent changes in habitat.

Rodents.—Twenty-five species of rodents are known to occur at BAND (Table 4). Guthrie and Large (1980) reported 24 species, and we documented 22 species during our field efforts. We documented one new species of rodent for the park, the bushy-tailed woodrat (*Neotoma cinerea*). We captured multiple individuals at higher elevations on Cerro Grande associated with rocky habitats in 2003 and 2004. During our efforts, we also captured 8 southern red-backed voles (*Clethrionomys gapperi*). Guthrie and Large (1980) only reported red-backed voles in the blue spruce forest atop Cerro Grande at 3048 m (10,000 ft). We discovered these voles were more widespread on the park and occurred at elevations as low as 2774 m (9100 ft) in mixed coniferous forests south of NW Hwy 4 in the extreme western part of BAND. Although bushy-tailed woodrats and red-backed voles are not as conspicuous as pika, we propose that these species also may serve as important indicators for future long-term monitoring at BAND. As with pika, these populations represent some of the southernmost populations of these species in North America. Because of the isolation of these outlying populations from populations to the North and because of their limited habitat in higher elevations of BAND, populations at BAND surely will serve as important indicators of health of these high-elevation, montane ecosystems in the future.

During 2003 and 2004, we captured 6 individuals of rock pocket mouse (*Chaetodipus intermedius*). Individuals were captured on dry rocky slopes of Cañon de los Frijoles and in similar habitats on the Tsankawi Unit. Guthrie and Large (1980) reported this species only from piñon-juniper slopes on the north side of the mouth of Alamo Canyon at 1737 m (5700 ft). Records from BAND represent the northernmost record of this species throughout its distribution, two new county records, and a 48-km range extension. Gennaro (1968) examined the distribution of this species at the northern limits of its range and discovered that its limits coincide with the 69˚F isotherm for average annual maximal temperatures. Above this isotherm suitable habitat existed but no mice were trapped. These data potentially suggest that environments in the region have warmed over the past few decades and mice have moved northward. Additional research on its distribution, as well as examination of temperatures over the last few decades in the region would surely lead to a better understanding of the ecology of this species. We propose this species also may serve as an important indicator for future long-term monitoring at BAND.

During summer 2004, we trapped for multiple nights in Cañon de los Frijoles for the meadow jumping mouse (*Zapus hudsonius*). Our attempt to capture this mouse was unsuccessful in the park. We still suspect that *Z. hudsonius* occurs at BAND in appropriate habitats, such as along the stream in upper parts of Cañon de los Frijoles. Unfortunately, our efforts in 2004 to capture this species were hampered by a raccoon that continually molested over half our traps each night. In fact, this individual even learned how to remove small mammals from traps, which further hampered our efforts to document the jumping mouse.

Recently, we confirmed the identification of voucher specimens of chipmunks (*Neotamias quadrivittatus* and *N. minimus*) and *Peromyscus* (*P. boylii* and *P. nasutus*) at BAND

using skull characteristics. These two pairs of species are similar in external characteristics and there is a relatively high potential to misidentify individuals using only external features, even when examining a series of study skins from the same location. We agree with Armstrong (1972), that upon superficial examination, chipmunks of the species *N. quadrivittatus* and *N. minimus* are difficult to identify even when specimens are in hand. In short, we originally thought that some chipmunks captured at high elevations from Cerro Grande might be Colorado chipmunks (*N. quadrivittatus*); however, after further investigations of skull size, we are confident that all of these high-elevation specimens from this area are least chipmunks (*N. minimus*). We did reconfirm that two specimens originally believed to be *N. quadrivittatus* were in fact Colorado chipmunks. One specimen was from a piñon/juniper woodland at lower elevations; however, our other voucher was captured at a relatively high elevation in a mixed coniferous forest on a trapline with red-backed voles (*C. gapperi*) and Mexican woodrats (*N. mexicana*). According to Findley et al. (1975), least chipmunks are most common on edges of spruce-fir forest, with Colorado chipmunks more common in lower ponderosa and mixed coniferous forests. We are confident of most of our identifications of chipmunks at BAND; however, some captures (and releases) of supposed least chipmunks in mixed coniferous and ponderosa pine forests are potentially problematic, especially without any vouchers from these habitats.

We also confirmed the identification of brush mice (*P. boylii*) and northern rock mice (*P. nasutus*) at BAND. Using a tooth character described by Hoffmeister (1986), we discovered that both species are present in the park. It appears that adult mice (i.e., those with fairly worn molars) are moderately easy to identify based on pelage coloration; however, subadult

individuals (i.e., those not in juvenile gray pelage but in recent adult pelage) are extremely hard to identify without examining the tooth character (see below in CHCU and ELMA).

Carnivores.—Eleven species of carnivores are known to occur at BAND (Table 4). Guthrie and Large (1980) reported all 11 species, and we documented 9 species during our field efforts. Guthrie and Large (1980) also reported potential sightings of red fox (*Vulpes vulpes*) along NM Hwy 4. This species probably occurs in the park, although there are no confirmed sightings or records.

Artiodactyls.—Four species of ungulates are known from BAND (Table 4). At present, only the mule deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*) inhabit the park; the bighorn sheep (*Ovis canadensis*) and feral ass (*Equus asinus*), an exotic, have been extirpated from the park.

Chaco Culture National Historical Park

In 2003 and 2004, we worked 75 person-days, accrued 3072 trap-nights, accumulated 4 net-nights, drove 5.5 hours spotlighting, and walked 87 km for carnivores and diurnal mammals towards fulfillment of our objective (Table 1). Overall, we documented 33 species of mammals at CHCU (Table 2). We captured or observed sign of 579 mammals, including 3 species of bats, 2 species of lagomorphs, 19 species of rodents, 6 species of carnivores, and 3 species of ungulates (Table 2).

At present, we have documentation of 50 extant species of mammals at CHCU, plus 1 historically documented species (Table 5). This number modestly exceeds the predicted species richness of 44 (Stuart 2000). Currently, the overall level of documentation for CHCU is 94%, with levels of documentation ranging from 75 to 100% for specific mammalian orders (Table 8).

At present, ungulates have the lowest documentation at 75% and insectivores, bats, lagomorphs, and rodents have documentation of 100% (Table 8). We determined that the previous level of documentation of mammals at BAND was 79% (Table 8). This relatively high level of documentation is a reflection of information gathered from previous unpublished reports by Valdez et al. (2002a) and Cully (1981). Additionally, there are a number of species with prior voucher material housed at various museums (see Findley et al. 1975). During our field efforts, we confirmed many small mammals at CHCU and secured voucher material of 16 species of rodent and 1 species of carnivore (Table 5).

Insectivores.—One species of shrew is known from CHCU. On 1 July 1999, E. W. Valdez observed a Crawford's desert shrew (*Notiosorex crawfordi*) while mist-netting bats at the park. The individual was observed along the base of a canyon wall near a mine on the east side of South Mesa (E. Valdez pers. comm.; 0236769E, 3991262N).

Bats.—Fifteen species of bats are known from CHCU (Table 5). Valdez et al. (2002a) originally reported 14 species at the park, but our efforts revealed one additional species (big free-tailed bat, *Nyctinomops macrotis*). In 2003 and 2004, we heard the conspicuous audible calls of *N. macrotis* on many evenings at the VIP campground in NPS housing area. Valdez et al. (2002a) only reported calls of the spotted bat at Wijiji Ruins and at the confluence of Chaco Wash and Chaco River. During our field efforts, we also heard the audible calls of spotted bats at the VIP campground in both 2003 and 2004. On 9 June 2004, with the aid of a spotlight, we observed a spotted bat as it flew low over the campground. We suspect that our observations of *N. macrotis* and *E. maculatum* are the result of individuals being attracted to the sewage disposal ponds (a permanent source of water) just above the campground. In summer 2003 and early summer 2004, the region was in an extreme drought, and water sources were limited in the park.

During our inventory, we examined places netted by Valdez et al. (2002a) and found no available water for bats except for the sewage disposal ponds. We actually observed bats drinking out of the southernmost sewage pond. Of the 15 species known to occur at CHCU, we feel that the spotted bat (*E. maculatum*), big free-tailed bat (*N. macrotis*), and Yuma myotis (*Myotis yumanensis*) are of special interest to CHCU and New Mexico. Both *N. macrotis* and *E. maculatum* are relatively patchy in distribution across their entire range, thus these records add to our understanding of their distribution and abundance. The Yuma myotis is of interest because it is generally thought to occur in areas with permanent watercourses (Findley et al. 1975). We would classify Chaco Wash, Chaco River, and auxiliary pools of water along canyon floors as intermittent sources of water. Thus, data reported by Valdez et al. (2002a) suggest that *M. yumanensis* may not always be associated with permanent sources of water in the state.

Lagomorphs.—Two species of rabbits are known from CHCU, the desert cottontail (*S. audubonii*) and black-tailed jackrabbit (*L. californicus*, Table 5). Both Cully (1981) and our inventory documented these species at CHCU. A third species of rabbit might occur, the eastern cottontail (*S. floridanus*). We have only included it on the master list as unconfirmed because appropriate habitats for this species do not appear to exist at CHCU. Specimens of *S. floridanus* are known from higher more mesic habitats on Mt. Taylor. On a couple of occasions on Chacra Mesa and at Pueblo Pintado, we observed some cottontails that appeared to have shorter ears. This trait helps to separate these two species in other parts of its distribution, but it was not mentioned in Findley et al. (1975) as a meaningful trait in New Mexico. We feel it would be advantageous to collect specimens from Chacra Mesa to verify that cottontails are truly *S. audubonii*. Some recent work suggests that eastern cottontails from mountainous portions of

western New Mexico represent another species, the Manzano mountain cottontail (*S. cognatus*, see Frey 2004).

Rodents.—Twenty one species of rodents have been documented from CHCU, including one historically reported species (Table 5). Of the 20 extant species, 17 were documented by Cully (1981), and we documented 19 species during our field efforts. In 2003, we captured two new species for the park, the brush mouse (*Peromyscus boylii*) and western white-throated woodrat (*Neotoma albigula*). The brush mouse was documented in brushy areas along bottoms of north-facing canyon walls and in rocky situations on Chacra Mesa. Western white-throated woodrats were captured in shrubby habitats on canyon floors, in rocky situations along canyon walls, and in rocky habitats on Chacra Mesa. These species are known from similar habitats across New Mexico (Findley et al. 1975) but were not detected during the survey by Cully (1981, 8600 trap nights). Thus, they may represent recent colonization events at CHCU or alternatively, their close morphological similarities with other species caused them to be overlooked.

In 2004, we captured eight bushy-tailed woodrats (*N. cinerea*) at CHCU although we were unable to document their presence in 2003. In 2004, our first two captures of *N. cinerea* were juveniles; both were captured in Sherman live traps. We first identified these individuals as *N. stephensi* due to intermediate bushiness of tails; however after further examination, we determined these individuals actually represented juvenile *N. cinerea* due to their large hind feet. It thus seems likely that our lack of captures of adult *N. cinerea* in 2003 reflected our use of only Sherman live traps. In October 2004, we returned to CHCU to attempt to catch adult *N. cinerea* with Tomahawk traps. After only a few days, we captured 6 adult *N. cinerea* in Tomahawk

traps, but none was captured on Chacra Mesa. We suspect that bushy-tailed woodrats are more widespread in the park than our present records reflect.

Additional study of distributions and population sizes of woodrats at CHCU might be of interest. Our data suggest that white-throated woodrats (*N. albigula*) may have recently colonized the park and the distribution of bushy-tailed woodrats (*N. cinerea*) may have been reduced, at least on Chacra Mesa. An alternative explanation is that Cully (1981) misidentified some woodrats at CHCU. We found *N. albigula* to inhabit shrubby habitats on canyon floors, rocky habitats on canyon walls, and rocky habitats on Chacra Mesa, including areas with piñon-juniper woodland. Bushy-tailed woodrats were discovered to occur only in rocky habitats associated with steep cliff walls. We also found Stephen's woodrats (*N. stephensi*) at CHCU; they were most common on Chacra Mesa and north-facing canyon walls.

According to Hoffmeister (1986), *N. cinerea* in northern Arizona lives in cliffs and rocky crevices, and the presence of protective shelters in rocky walls appears more important than vegetative type. Findley et al. (1975) report that *N. cinerea* from northwestern New Mexico occurs along the bases of sandstone cliffs and lesser rock outcrops. These comments are in agreement with our captures of *N. cinerea* along steep cliff walls at CHCU. For *N. stephensi* in Arizona Hoffmeister (1986) notes they are found most frequently in piñon-juniper woodland, especially where rocks are present; we documented *N. stephensi* in similar shrubby habitats. However, Cully (1981) reported *N. stephensi* from a wash dominated by perennial cover, grasses, and rabbit brush and in a shrubby habitat dominated by saltbush (*Atriplex*) and Greasewood (*Sarcobatus*). In other parts of New Mexico, *N. albigula* is not dependent on rocks and occurs in a variety of habitats (Findley et al. 1975, Geluso and Geluso 2004, K. Geluso unpublished data). Thus, Cully's captures of *Neotoma* on canyon floors lacking rocks might

actually have been *N. albigula*. Furthermore, we suspect that at least some of Cully's (1981) captures of *N. cinerea* were in fact *stephensi.*

We confirmed the identification of brush mice (*P. boylii*) at CHCU using a tooth character described by Hoffmeister (1986). Originally, we determined that a few individuals captured were brush mice based solely on pelage characteristics. Our identifications of these individuals were supported by the tooth characteristic. In contrast, we had six voucher specimens where the identification was problematic using pelage coloration. At first, we suspected these individuals might represent northern rock mice (*P. nasutus*) based on gray/yellow coloration of the dorsum. However, the tooth character revealed that all these individuals were brush mice, many of which were subadults based on the tooth wear. Again, it appears that adult mice (i.e., those with fairly worn molars) are moderately easy to identify by pelage coloration; however, subadult individuals (i.e., those not in juvenile gray pelage but in recent adult pelage) are difficult to identify without examining the skulls. Adult brush mice generally can distinguished from adult northern rock mice by the presences of orange/reddish coloration on the dorsum and rump; adult northern rock mice have a yellow/gray coloration on dorsum and rump.

Carnivores.—Nine species of carnivores are known from CHCU (Table 5). Cully (1981) reported five species, and we documented 6 species during our field efforts. There are three species of mesocarnivores that probably will eventually be found at CHCU (*Bassariscus astutus*, *Procyon lotor*, and *Mustela frenata*). We suspect these species currently occur at the park in low abundance. There is one documented record of an American black bear (*Ursus americanus*) from CHCU. On 17 May 2000, an individual was observed by the housing area. Photographs of tracks in the soil were taken by park personnel and placed in NPS files at the park.

Artiodactyls.—Three species of ungulates are known from CHCU (Table 5). One of these three, elk (*Cervus canadensis*) is a relatively recent arrival to the park. Only within the last 10 years have elk been observed at CHCU. Today, approximately 50 individuals roam the park, including bulls, cows, and calves (B. Shattuck pers. comm.). A study by researchers at New Mexico State University is currently investigating the usage and impacts of elk on different habitats in the park. We commonly observed elk on Chacra Mesa and along Chaco Wash. During our inventory, we found a horn sheath of a goat (*Capra hircus*). Park employees report that feral individuals occasionally wander on park property.

El Malpais National Monument

In 2003 and 2004, we worked 69 person-days, accrued 3010 trap-nights, accumulated 9 net-nights, drove 6 hours spotlighting, and walked 108 km for carnivores and diurnal mammals towards fulfillment of our objective (Table 1). Overall, we documented 45 species of mammals at ELMA (Table 2). We captured or observed sign of 737 mammals, including 12 species of bats, 2 species of lagomorphs, 20 species of rodents, 8 species of carnivores, and 3 species of ungulates (Table 2).

At present, we have documentation of 53 extant species of mammals at ELMA (Table 6). This number modestly exceeds the predicted species richness of 48 (Stuart 2000). Currently, the overall level of documentation for ELMA is 90%, with levels of documentation ranging from 0 to 100% for specific mammalian orders (Table 9). At present, shrews have the lowest documentation at 0%, and bats, rabbits, and ungulates have the highest documentation at 100% (Table 9). The previous level of documentation of mammals at ELMA was 66% (Table 9). This moderate level of documentation is a reflection of information gathered from an unpublished

report by Valdez et al. (2002b) and from Hooper (1941). During our field efforts, we confirmed additional small mammals at ELMA and secured voucher material of 1 species of bat and 17 species of rodent (Table 6).

Insectivores.—To date, there are no documented records of shrews from ELMA (Table 6). We suspect that Crawford's desert shrew (*Notiosorex crawfordi*) occurs in grassland habitats around the edge of lava fields. The montane shrew (*Sorex monticolus*) may occur in the area, but this species is generally found at elevations above 7500 ft in mesic situations (Findley et al. 1975). Both species of shrew may occur around ponds in the northwestern part of ELMA and in grassland habitats in the disjunct parcel of land near Grants.

Bats.—Fourteen species of bats are known from ELMA (Table 6). Valdez et al. (2002b) originally reported 16 species. Valdez et al. (2002b) reported captures of the Southwestern myotis (*Myotis auriculus*) from the park. We have examined their voucher material from ELMA and find these specimens are best referred to as long-eared myotis (*M. evotis*). Valdez et al. (2002b) also report the occurrence of Yuma myotis (*M. yumanensis*) from the park, but also noted that their documentation was problematic as this record was based on ultrasonic recordings. The calls may actually represent California myotis (*M. californicus*). Until more definitive evidence is presented for these two species, we have not included them as part of the mammalian fauna of the park (Table 6).

Valdez et al. (2002b) reported on the first records of spotted bats (*E. maculatum*) in Cibola County on NM Hwy 117 between La Ventana Natural Arch and the Lava Falls parking lot. During our present inventory, we also heard the conspicuous audible calls of *E. maculatum* on park property near La Ventana Natural Arch in 2004.

On two occasions in 2004, we netted the entrance to the Bat Cave in the El Calderon Area. On 27 May, we captured 10 Brazilian free-tailed bats (*Tadarida brasiliensis*), 4 Townsend's big-eared bats (*Corynorhinus townsendii*), and 2 California/western small-footed bats (*Myotis californicus*/*ciliolabrum*). We estimated the outflight of *T. brasiliensis* at approximately 75-100 individuals. We captured both sexes of *T. brasiliensis*, only female *C. townsendii*, and only male *M. californicus*/*ciliolabrum*. On 27 August, we again netted the entrance to the Bat Cave and captured 50 *T. brasiliensis* (41 males and 9 females) and 1 *M. ciliolabrum*, but could not observe the outflight of bats. On 28 August, we observed the emergence of bats from outside the lava tube. We would conservatively estimate the outflight of bats at 15,000 to 20,000 individuals. The outflight was continuous for almost an hour. As discussed by Valdez et al. (2002b), we feel that the Bat Cave in the El Calderon area is very susceptible to human disturbance. Examination of the floor at the entrance to the cave showed a considerable amount of human footprints, although there is a precautionary sign to inform and discourage public entry. We propose that consideration be given to exclude humans from this and other caves containing large numbers or maternity colonies of bats.

Lagomorphs.—Two species of rabbits are known from ELMA, the desert cottontail (*S. audubonii*) and black-tailed jackrabbit (*L. californicus*, Table 6). Both Hooper (1941) and our inventory documented these species at the park.

Rodents.—Twenty two species of rodents are known from ELMA (Table 6). Hooper (1941) documented 14 species, and we documented 21 species during our inventory. In 2003 and 2004, our efforts yielded eight species previously undocumented at ELMA, including the Colorado chipmunk (*Neotamias quadrivittatus*), spotted ground squirrel (*Spermophilus spilosoma*), plains pocket mouse (*Perognathus flavescens*), banner-tailed kangaroo rat

(*Dipodomys spectabilis*), western harvest mouse (*Reithrodontomys megalotis*), piñon mouse (*Peromyscus truei*), tawny-bellied cotton rat (*Sigmodon fulviventer*), and Mogollon vole (*Microtus mogollonensis*). Many of these species were reported in the region by Hooper (1941), but documentation was lacking from ELMA or on lands immediately adjacent to park property.

Our most significant capture at ELMA was the discovery of the tawny-bellied cotton rat (*S. fulviventer*). Our records of *S. fulviventer* represent a 108-km westward expansion of this species into west-central New Mexico. Individuals were captured in both 2003 and 2004, and suggest that grassy habitats on the disjunct part of the park near Grants provides a refugium for this and other grassland species during drought years (Geluso et al. In press).

Both the Mogollon vole (*M. mogollonensis*) and western harvest mouse (*R. megalotis*) are of interest today because Hooper (1941) reported both species as rare in the region. Hooper captured only a single vole and two harvest mice during his entire survey in the region. In contrast, we captured 6 voles and 27 harvest mice during our inventory. Hooper (1941) noted that rarity of both species is probably due, in large part, to the scarcity of suitable habitats. Hooper reported that grass, weeds, and other low-lying vegetation was sparse and kept heavily grazed by livestock. The lack of grazing on lands administered by the Park Service appears beneficial for grassland species.

The small parcel of land near Grants likely was acquired for the construction of the Information Center along Interstate 40; however, biologically this land represents an important and unique habitat in the region. If additional lands in the area became available for purchase, NPS may wish to consider purchasing such property. With additional surveys, other species of mammals not yet documented on the park may be found in these grassy and potentially mesic habitats. These species include the montane shrew (*S. monticolus*), Crawford's desert shrew (*N.*

crawfordi), white-footed mouse (*Peromyscus leucopus*), southern plains woodrat (*Neotoma micropus*), meadow vole (*Microtus pennsylvanicus*), house mouse (*Mus musculus*), and northern raccoon (*Procyon lotor*).

The identifications of brush mice (*P. boylii*) and northern rock mice (*P. nasutus*) at ELMA were confirmed using a tooth character described by Hoffmeister (1986). Originally, we determined that a handful of individuals kept as vouchers were brush mice, based solely on pelage characters. Our identifications of these individuals were supported by the tooth character. In addition, some individuals kept as voucher *P. nasutus* were confirmed with pelage and tooth characters. However, we discovered that a handful of subadult vouchers originally identified as northern rock mice were actually best referred to as brush mice.

Carnivores.—Eleven species of carnivores have been documented from ELMA (Table 6). Hooper (1941) discovered that 7 species were present, and our efforts documented 9 species. We strongly suspect that an additional three species occur at ELMA but have gone undetected. These species include the northern raccoon (*P. lotor*), American badger (*Taxidea taxus*), and western spotted skunk (*Spilogale gracilis*). Our documentation of the red fox (*Vulpes vulpes*) in west-central New Mexico suggests that it is more widespread in the state than previously thought (see Mikesic and Larue 2003). Only scattered records of red fox exist across the state, with most records located in the northwest and north-central parts of New Mexico. The record of white-backed hog-nosed skunk (*Conepatus leuconotus*) from the Malpais is interesting to note. This record by Hooper (1941) represents one of the northernmost records for New Mexico. To our knowledge, there are no recent records in central or northern parts of the state in at least the last 50 years.

Artiodactyls.—Five species of ungulates have been documented from ELMA, including one historically reported species (Table 6). Of the four extant species, two were documented by Hooper (1941), and we documented three species during our field efforts.

DISCUSSION

Challenge of Species Documentation on National Parks

Our efforts to document mammalian species on these three parks during the last two years should be viewed as a work in progress. This is because several factors affect these efforts. One especially problematic area is exactly what list of species should be used as the measuring stick against which documentation is assessed. We have chosen to use a list of species that we deem "likely" to occur, based on our work, our knowledge of mammals of the Colorado Plateau, and pertinent references. These likely species are those listed as "Present" and "Probably Present" on our Master Species Lists (Tables 4, 5, and 6). For smaller parks, this method may be somewhat too inclusive. For larger parks (such as BAND, CHCU, and ELMA), we suspect that this method better reflects current mammalian fauna. Current lists for our three parks probably are good "working" lists, at least at this point in time. Typically, those parks that had some demonstrated level of previous work, or for which a knowledgeable employee is present, are those parks that are closest to 90% level of documentation.

Our estimates for inventory completeness after our two years of effort increased moderately from those used by the SCPN as "starting points" for this inventory effort (Stuart 2000). These figures (NPS estimate, followed by our final estimate) for the three parks are: BAND: 80%, 89%; CHCU: 80%, 94%; and ELMA: 80%, 90%. The source of the original estimates is unknown but it was probably local park staff. We believe that many parks over-

estimated the extent of documentation, perhaps because they worked from a smaller, less-inclusive list than we are using. Small, poorly-known, and secretive species such as bats and small rodents frequently were overlooked. Additionally, they may have been unaware of previous work as it is not always well-documented or well-known in park files. Although at first glance the percentages appeared relatively accurate, the total number of species predicted on parks fell well short of total likely species.

Park size undoubtedly influences species diversity and a variety of mathematical algorithms incorporate size in attempting to predict the numbers of species (but not actual species) that may occur on a park. However, the algorithms used by SCPN to estimate species richness of mammals on the parks (Stuart 2000) were flawed. In all cases, our totals of likely species exceeded original park estimates (Stuart 2000). These figures (NPS estimate, followed by our final estimate) for the three parks are: BAND: 44, 66; CHCU: 44, 53; and ELMA: 48, 59.

Our previous experience in this effort has been that documentation levels are typically highest for larger parks. Although we predict more species of mammals at larger parks, it is not clear to us whether documentation would be predicted to be "easier" on large parks. Nonetheless, greater habitat diversity may lead to more places that can be sampled (e.g., pools for mist netting bats), larger populations of some species (especially resident carnivores) that might make them relatively easier to document, a tendency to attract researchers who initiated studies that document mammals, and a greater likelihood that there will be resident NPS naturalists, biologists, or knowledgeable employees.

Another factor in assessing species occurrence is the biology of the animals that we are trying to document. It is an axiom in biology that only a few species are truly common and most others are much less common to rare. The occurrence of common, widespread, and abundant

species, such as *P. maniculatus*, is easy to document and our results offer visible proof of this (Table 2 and 3). However, less common and rare species can be very difficult to document and absolute absence is difficult to prove.

Long-term climate trends, as well as local weather conditions, can affect inventory efforts. During most of our efforts the last two years, New Mexico was in a moderate to severe drought. In general, rodent populations are consequently lower than at times of greater precipitation. Locally, inclement weather depresses activity of small mammals (and mammalogist) and the efficiency of methods used to inventory them. Rainfall can dissolve bait, cause traps to trigger, and turn mist nets into soggy, non-functional curtains of water. Aspects of climate and especially availability of water affect our ability to inventory bats. Bats are dependent on the availability of roosting sites, water sources, and adequate prey. The extent of available water in a given area, as well as subtleties of pond shape and size, can affect capture success of bats (Kunz and Kurta 1988, K. N. Geluso personal communication). Typically, captures of bats in mist nets are lower when water is abundant, as the bats seem to be more dispersed over the landscape. When water sources are fewer, bats tend to concentrate at those waterholes that are available (mammalogists exploit this tendency when possible). Finally, landscape changes at the parks can affect our results. For example, portions of BAND burned prior to our inventory efforts in 2003, and we do not know how, or if, that influenced our results at that park. Likewise, subtle seasonal changes in the natural history of different species or the physical environment my influence inventory efforts.

CONCLUSIONS AND RECOMMENDATIONS

We believe the task of documenting 90% of expected species of mammals on these three national parks went very well during our two-year effort. Compared to our previous efforts on the NCPN and SCPN, we had much higher levels of overall documentation. This likely reflects both the talents of the field mammalogists conducting the inventory as well as the earlier work on bats at these parks, thus allowing a more focused effort on non-volant mammals. As others have noted, "proving" that a species does not occur can be extremely difficult and that is now the task at hand. As noted above, the groups requiring further documentation vary from park to park, but the actual number of species requiring additional effort is about six species per park. For the three parks, documentation of insectivores varies from 0 to 100%, bats appear complete at 100%, lagomorphs appear complete at 100%, rodents vary from 92 to 100%, carnivores vary from 79 to 85%, and artiodactyls vary from 75 to 100%.

If it is important to document the remaining species, careful thought should be given to the following:

a) inventories are different than monitoring and the two should not be confused;

b) inventories require specialists who are familiar with the region and its species;

c) a standard museum voucher specimen is the only evidence that is unequivocal;

d) rare and uncommon species still needing documentation are unlikely to be found as a result of random surveys;

e) levels of precision for associated data (e.g., GPS coordinates) should be determined in advance and with thought given to the mobility of the species;

f) sufficient time must be allocated to accomplish the task; and

g) sufficient funding must be allocated to accomplish the task.

We have been asked to provide our comments on the next phase of this program, namely monitoring. We are aware that intensive discussions have already occurred on this topic and will keep our comments to a minimum. We encourage parks and networks to consider assigning priority for monitoring to:

a) species known to be declining on the basis of statistically defensible trend data, where such data exist;

b) species that are unique to a given park, or a region within which a park occurs; and

c) areas or habitats that are unique to a park, especially those areas that appear to have high biological diversity (noted in text and tables in this report).

We feel the following list represents some of the most significant or important issues concerning future monitoring or documentation of mammals at these three parks. Additional details for some of these topics also can be found in the Results.

Bandelier National Monument:

a) monitor populations of mammals (e.g., *O. princeps, N. cinerea, C. gapperi*) restricted to high-elevations;
b) search for additional species of shrews with pitfall traps;
c) trap upper regions of canyons (e.g., Cañon de los Frijoles) in fairly lush, low-growing vegetation adjacent to streams for the meadow jumping mouse (*Z. hudsonius*); and
d) monitor the response of mammals (from shrews to ungulates) in prescribed burns as well as areas burned by catastrophic fires (e.g. the Cerro Grande fire).

Chaco Culture National Historical Park:

a) trap for the desert shrew (*N. crawfordi*) using pitfall traps to properly document its occurrence on the park;
b) mist net large open sources of water for the big free-tailed bat (*N. macrotis*);
c) determine if only one species of cottontail occurs on Chacra Mesa by obtaining some voucher specimens;
d) monitor populations of woodrats throughout the park in various habitats;
e) use mid- to large-sized tomahawk traps to attempt to document a number of mesocarnivores suspected to occur at the park; and
f) examine the response of vegetation to the recent encroachment of elk on the park.

El Malpais National Monument:

a) trap for shrews using pitfall traps in grassy habitats in the disjunct parcel of land by Interstate 40;
b) monitor the status of small mammals on this same parcel of land (i.e., the continued presence of *S. fulviventer*, the possible expansion of *P. leucopus* into the region, and the expected house mouse, *M. musculus*); and
c) determine if the colony of *T. brasiliensis* at the Bat Cave represents a maternity colony.

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TABLE 1. Field schedule and summary of effort for mammalian inventories during 2003-2004 at Bandelier National Monument (BAND), Chaco Culture National Historical Park (CHCU), and El Malpais National Monument (ELMA). Trips to parks are listed in chronological order including dates, parks, observers, effort, and sampling methods.

Dates(s)	Park visited	Observers(s)	Person days	Trap nights	Net nights	Hours spotlighting driving roads	Track-scat survey distance (km)	Sampling method(s)
19-23 May 03	CHCU	L. Harding	5			2.5	33	diurnal track-scat surveys, nocturnal spotlighting surveys
24-28 May 03	ELMA	L. Harding	5			2	36	diurnal track-scat surveys, nocturnal spotlighting surveys
2-11 June 03	BAND	L. Harding	10			2	99	diurnal track-scat surveys, nocturnal spotlighting surveys
6-19 June 03	BAND	K. Geluso, V. Ashe, J. Hoffman, J. White	54	2182	5			small mammal traplines, mist netting for bats
16-20 June 03	CHCU	L. Harding	5			2	33	diurnal track-scat surveys, nocturnal spotlighting surveys
28 June-7 July 03	CHCU	K. Geluso, V. Ashe, J. Hoffman, J. White	37	1920				small mammal traplines
30 June-4 July 03	ELMA	L. Harding	5			1	36	diurnal track-scat surveys, nocturnal spotlighting surveys
5-8 July 03	BAND	L. Harding	4			2	40	diurnal track-scat surveys, nocturnal spotlighting surveys
16-24 July 03	ELMA	K. Geluso, V. Ashe, J. Hoffman, J. White	33	2045	2			small mammal traplines, mist netting for bats

TABLE 1. Continued

Dates(s)	Park visited	Observers(s)	Person days	Trap nights	Net nights	Hours spotlighting driving roads	Track-scat survey distance (km)	Sampling method(s)
30 July-2 Aug 03	ELMA	K. Geluso, V. Ashe	8	441				small mammal traplines
11-15 August 03	ELMA	L. Harding	5			1	36	diurnal track-scat surveys, nocturnal spotlighting surveys
17-20 August 03	BAND	L. Harding	4				39	diurnal track-scat surveys
25-28 May 04	ELMA	K. Geluso R. Ligon	8	286	2			small mammal traplines, mist netting for bats
2-11 June 04	CHCU	K. Geluso R. Ligon	20	671	4			small mammal traplines, mist netting for bats
17 June–1 July 04	BAND	K. Geluso J. Mink R. Ligon J. Hoffman	60	1500	8			small mammal traplines, mist netting for bats
26-30 Aug 04	ELMA	K. Geluso	5	238	5	2		small mammal traplines, mist netting for bats, nocturnal spotlighting surveys
19-25 Oct 04	CHCU	K. Geluso	7	466		1		small mammal traplines, nocturnal spotlighting surveys
20 Dec 04	CHCU	K. Geluso	1	15			21	diurnal mammal search
TOTAL			276	9764	26	15.5	373	

TABLE 2. Summary of mammals captured or observed during 2003-2004 at Bandelier National Monument (BAND), Chaco Culture National Historical Park (CHCU), and El Malpais National Monument (ELMA).

Order Scientific name	BAND 2003	BAND 2004	CHCU 2003	CHCU 2004	ELMA 2003	ELMA 2004	Total 2003	Total 2004	Grand total
Insectivora									
Sorex monticolus	--	2	--	--	--	--	--	2	2
Sorex palustris	--	1	--	--	--	--	--	1	1
Chiroptera									
Myotis californicus	--	--	--	--	--	1	--	1	1
Myotis ciliolabrum	1	1	--	--	--	3	1	4	5
Myotis ciliolabrum/californicus	--	6	--	--	--	11	--	17	17
Myotis evotis	10	9	--	--	34	16	44	25	69
Myotis thysanodes	--	14	--	--	7	11	7	25	32
Myotis volans	8	23	--	--	3	--	11	23	34
Lasiurus cinereus	6	3	--	--	1	1	7	4	11
Lasionycteris noctivagans	55	31	--	--	--	4	55	35	90
Eptesicus fuscus	4	2	--	--	19	5	23	7	30
Euderma maculatum	2	1	--	1	--	4	2	6	8
Corynorhinus townsendii	--	1	--	--	2	4	2	5	7
Antrozous pallidus	--	2	--	1	--	1	--	4	4
Tadarida brasiliensis	--	1	--	--	--	64	--	65	65
Nyctinomops macrotis	1	1	1	3	--	--	2	4	6
Lagomorpha									
Ochotona princeps	2	4	--	--	--	--	2	4	6
Sylvilagus audubonii	1	1	4	5	--	3	5	9	14
Sylvilagus nuttallii	2	4	--	--	--	--	2	4	6
Sylvilagus spp.	--	1	--	2	--	1	--	4	4
Lepus californicus	--	--	1	1	1	2	2	3	5

TABLE 2. Continued

Order Scientific name	BAND 2003	BAND 2004	CHCU 2003	CHCU 2004	ELMA 2003	ELMA 2004	Total 2003	Total 2004	Grand total
Rodentia									
Neotamias dorsalis	--	--	--	--	3	7	3	7	10
Neotamias minimus	20	31	--	--	--	--	20	31	51
Neotamias quadrivittatus	22	18	4	3	1	--	27	21	48
Neotamias spp.	--	8	--	--	--	--	--	8	8
Ammospermophilus leucurus	--	--	8	8	--	--	8	8	16
Spermophilus lateralis	6	9	--	--	--	--	6	9	15
Spermophilus spilosoma	--	--	--	--	--	1	--	1	1
Spermophilus variegatus	6	6	--	3	3	4	9	13	22
Cynomys gunnisoni	--	--	2	13	7	5	9	18	27
Sciurus aberti	5	3	--	--	--	--	5	3	8
Tamiasciurus hudsonicus	5	6	--	--	--	--	5	6	11
Thomomys bottae	6	1	--	1	1	--	7	2	9
Thomomys talpoides	1	--	--	--	--	--	1	--	1
Perognathus flavescens	--	--	4	2	4	--	8	2	10
Perognathus flavus	1	--	9	16	54	7	64	23	87
Chaetodipus intermedius	4	2	--	--	--	--	4	2	6
Dipodomys ordii	--	--	1	9	13	--	14	9	23
Dipodomys spectabilis	--	--	5	3	2	--	7	3	10
Castor canadensis	2	--	--	--	--	--	2	--	2
Reithrodontomys megalotis	--	--	3	6	16	11	19	17	36
Peromyscus boylii	9	--	6	7	5	5	20	12	32
Peromyscus crinitus	--	--	27	32	--	--	27	32	59
Peromyscus leucopus	1	--	--	--	--	--	1	--	1
Peromyscus maniculatus	37	168	58	50	59	45	154	263	417
Peromyscus nasutus	27	3	--	--	22	9	49	12	61
Peromyscus truei	15	12	5	50	21	23	41	85	126

TABLE 2. Continued

Order Scientific name	BAND 2003	BAND 2004	CHCU 2003	CHCU 2004	ELMA 2003	ELMA 2004	Total 2003	Total 2004	Grand total
Peromyscus boylii/nasutus	18	--	--	--	4	--	22	--	22
Onychomys leucogaster	--	--	48	6	9	1	57	7	64
Sigmodon fulviventer	--	--	--	--	13	9	13	9	22
Neotoma albigula	5	3	4	15	34	9	43	27	70
Neotoma cinerea	2	2	--	8	--	--	2	10	12
Neotoma mexicana	20	27	--	--	15	12	35	39	74
Neotoma stephensi	--	--	2	17	--	--	2	17	19
Neotoma spp. (juv.)	--	--	--	2	--	--	--	2	2
Clethrionomys gapperi	1	7	--	--	--	--	1	7	8
Microtus longicaudus	18	69	--	--	--	--	18	69	87
Microtus mogollonensis	--	--	--	--	--	6	--	6	6
Microtus montanus	2	17	--	--	--	--	2	17	19
Erethizon dorsatum	--	--	6	1	1	--	7	1	8
Carnivora									
Canis latrans	23	1	22	5	17	5	62	11	73
Vulpes macrotis	--	--	3	--	4	--	7	--	7
Urocyon cinereoargenteus	12	1	2	--	4	--	18	1	19
Ursus americanus	22	--	--	--	8	--	30	--	30
Bassariscus astutus	2	--	--	--	--	1	2	1	3
Procyon lotor	7	4	--	--	--	--	7	4	11
Mustela frenata	1	--	--	--	1	--	2	--	2
Taxidea taxus	--	--	2	--	--	--	2	--	2
Mephitis mephitis	1	--	--	--	--	--	1	--	1
Puma concolor	1	--	4	--	4	--	9	--	9
Lynx rufus	15	--	23	1	7	--	45	1	46

TABLE 2. Continued

Order Scientific name	BAND 2003	BAND 2004	CHCU 2003	CHCU 2004	ELMA 2003	ELMA 2004	Total 2003	Total 2004	Grand total
Artiodactyla									
Cervus elaphus	39	23	6	17	17	5	62	45	107
Odocoileus hemionus	15	4	17	13	5	11	37	28	65
Antilocapra americana	--	--	--	--	9	--	9	--	9
Capra hircus	--	--	1	--	--	--	1	--	1
Totals	463	533	278	301	430	307	1171	1141	2312

TABLE 3. Total number and percent relative abundance of observations during 2003-2004 mammalian inventories at Bandelier National Monument (BAND), Chaco Culture National Historical Park (CHCU), and El Malpais National Monument (ELMA).

Order Scientific name	BAND number	BAND percent	CHCU number	CHCU percent	ELMA number	ELMA percent	Total number	Total percent
Insectivora								
Sorex monticolus	2	0.20	--	--	--	--	2	0.09
Sorex palustris	1	0.10	--	--	--	--	1	0.04
Chiroptera								
Myotis californicus	--	--	--	--	1	0.14	1	0.04
Myotis ciliolabrum	2	0.20	--	--	3	0.41	5	0.22
Myotis ciliolabrum/californicus	6	0.60	--	--	11	1.49	17	0.74
Myotis evotis	19	1.91	--	--	50	6.78	69	2.98
Myotis thysanodes	14	1.41	--	--	18	2.44	32	1.38
Myotis volans	31	3.11	--	--	3	0.41	34	1.47
Lasiurus cinereus	9	0.90	--	--	2	0.27	11	0.48
Lasionycteris noctivagans	86	8.63	--	--	4	0.54	90	3.89
Eptesicus fuscus	6	0.60	--	--	24	3.26	30	1.30
Euderma maculatum	3	0.30	1	0.17	4	0.54	8	0.35
Corynorhinus townsendii	1	0.10	--	--	6	0.81	7	0.30
Antrozous pallidus	2	0.20	1	0.17	1	0.14	4	0.17
Tadarida brasiliensis	1	0.10	--	--	64	8.68	65	2.81
Nyctinomops macrotis	2	0.20	4	0.69	--	--	6	0.26
Lagomorpha								
Ochotona princeps	6	0.60	--	--	--	--	6	0.26
Sylvilagus audubonii	2	0.20	9	1.55	3	0.41	14	0.61
Sylvilagus nuttallii	6	0.60	--	--	--	--	6	0.26
Sylvilagus spp.	1	0.10	2	0.35	1	0.14	4	0.17
Lepus californicus	--	--	2	0.35	3	0.41	5	0.22

TABLE 3. Continued

Order Scientific name	BAND number	BAND percent	CHCU number	CHCU percent	ELMA number	ELMA percent	Total number	Total percent
Rodentia								
Neotamias dorsalis	--	--	--	--	10	1.36	10	0.43
Neotamias minimus	51	5.12	--	--	--	--	51	2.21
Neotamias quadrivittatus	40	4.02	7	1.21	1	0.14	48	2.08
Neotamias spp.	8	0.80	--	--	--	--	8	0.35
Ammospermophilus leucurus	--	--	16	2.76	--	--	16	0.69
Spermophilus lateralis	15	1.51	--	--	--	--	15	0.65
Spermophilus spilosoma	--	--	--	--	1	0.14	1	0.04
Spermophilus variegatus	12	1.20	3	0.52	7	0.95	22	0.95
Cynomys gunnisoni	--	--	15	2.59	12	1.63	27	1.17
Sciurus aberti	8	0.80	--	--	--	--	8	0.35
Tamiasciurus hudsonicus	11	1.10	--	--	--	--	11	0.48
Thomomys bottae	7	0.70	1	0.17	1	0.14	9	0.39
Thomomys talpoides	1	0.10	--	--	--	--	1	0.04
Perognathus flavescens	--	--	6	1.04	4	0.54	10	0.43
Perognathus flavus	1	0.10	25	4.32	61	8.28	87	3.76
Chaetodipus intermedius	6	0.60	--	--	--	--	6	0.26
Dipodomys ordii	--	--	10	1.73	13	1.76	23	0.99
Dipodomys spectabilis	--	--	8	1.38	2	0.27	10	0.43
Castor canadensis	2	0.20	--	--	--	--	2	0.09
Reithrodontomys megalotis	--	--	9	1.55	27	3.66	36	1.56
Peromyscus boylii	9	0.90	13	2.25	10	1.36	32	1.38
Peromyscus crinitus	--	--	59	10.19	--	--	59	2.55
Peromyscus leucopus	1	0.10	--	--	--	--	1	0.04
Peromyscus maniculatus	205	20.58	108	18.65	104	14.11	417	18.04
Peromyscus nasutus	30	3.01	--	--	31	4.21	61	2.64
Peromyscus truei	27	2.71	55	9.50	44	5.97	126	5.45

TABLE 3. Continued

Order Scientific name	BAND number	BAND percent	CHCU number	CHCU percent	ELMA number	ELMA percent	Total number	Total percent
Peromyscus boylii/nasutus	18	1.81	--	--	4	0.54	22	0.95
Onychomys leucogaster	--	--	54	9.33	10	1.36	64	2.77
Sigmodon fulviventer	--	--	--	--	22	2.99	22	0.95
Neotoma albigula	8	0.80	19	3.28	43	5.83	70	3.03
Neotoma cinerea	4	0.40	8	1.38	--	--	12	0.52
Neotoma mexicana	47	4.72	--	--	27	3.66	74	3.20
Neotoma stephensi	--	--	19	3.28	--	--	19	0.82
Neotoma spp. (juv.)	--	--	2	0.35	--	--	2	0.09
Clethrionomys gapperi	8	0.80	--	--	--	--	8	0.35
Microtus longicaudus	87	8.73	--	--	--	--	87	3.76
Microtus mogollonensis	--	--	--	--	6	0.81	6	0.26
Microtus montanus	19	1.91	--	--	--	--	19	0.82
Erethizon dorsatum	--	--	7	1.21	1	0.14	8	0.35
Carnivora								
Canis latrans	24	2.41	27	4.66	22	2.99	73	3.16
Vulpes macrotis	--	--	3	0.52	4	0.54	7	0.30
Urocyon cinereoargenteus	13	1.31	2	0.35	4	0.54	19	0.82
Ursus americanus	22	2.21	--	--	8	1.09	30	1.30
Bassariscus astutus	2	0.20	--	--	1	0.14	3	0.13
Procyon lotor	11	1.10	--	--	--	--	11	0.48
Mustela frenata	1	0.10	--	--	1	0.14	2	0.09
Taxidea taxus	--	--	2	0.35	--	--	2	0.09
Mephitis mephitis	1	0.10	--	--	--	--	1	0.04
Puma concolor	1	0.10	4	0.69	4	0.54	9	0.39
Lynx rufus	15	1.51	24	4.15	7	0.95	46	1.99

TABLE 3. Continued

Order Scientific name	BAND number	BAND percent	CHCU number	CHCU percent	ELMA number	ELMA percent	Total number	Total percent
Artiodactyla								
Cervus elaphus	62	6.22	23	3.97	22	2.99	107	4.63
Odocoileus hemionus	19	1.91	30	5.18	16	2.17	65	2.81
Antilocapra americana	--	--	--	--	9	1.22	9	0.39
Capra hircus	--	--	1	0.17	--	--	1	0.04
Totals	996	100.00	579	100.00	737	100.00	2312	100.00

TABLE 4. Master list of mammals of Bandelier National Monument (BAND), including those with uncertain status. Observations of species during our inventory are listed in the "Reference/Observation" column as USGS. Species with previously published voucher material are also shown in this column (MSB = Museum of Southwestern Biology, University of New Mexico).

Scientific Name	Common Name	Park Status	Reference/Observation
Sorex cinereus	masked shrew	Probably Present	Kirkland & Findley 1996
Sorex merriami	Merriam's shrew	Probably Present	
Sorex monticolus	montane shrew	Present	Guthrie and Large 1980; USGS 2004-voucher
Sorex nanus	dwarf shrew	Probably Present	Findley et al. 1975
Sorex palustris	water shrew	Present	USGS 2004-voucher
Sorex preblei	Preble's shrew	Probably Present	Kirkland & Findley 1996
Myotis californicus	California myotis	Present	Bogan et al. 1998
Myotis ciliolabrum	western small-footed myotis	Present	Bogan et al. 1998; USGS 2003, 2004-captures
Myotis evotis	long-eared myotis	Present	Bogan et al. 1998; USGS 2003, 2004-captures
Myotis thysanodes	fringed myotis	Present	Bogan et al. 1998; USGS 2004-captures
Myotis volans	long-legged myotis	Present	Bogan et al. 1998; USGS 2003, 2004-captures
Myotis yumanensis	Yuma myotis	Present	Bogan et al. 1998
Lasiurus cinereus	hoary bat	Present	Bogan et al. 1998; USGS 2003, 2004-captures
Lasionycteris noctivagans	silver-haired bat	Present	Bogan et al. 1998; USGS 2003, 2004-voucher
Pipistrellus hesperus	western pipistrelle	Present	Bogan et al. 1998
Eptesicus fuscus	big brown bat	Present	Bogan et al. 1998; USGS 2003, 2004-voucher
Euderma maculatum	spotted bat	Present	Bogan et al. 1998; USGS 2003, 2004-audible calls
Corynorhinus townsendii	Townsend's big-eared bat	Present	Bogan et al. 1998; USGS 2004-capture
Antrozous pallidus	pallid bat	Present	Bogan et al. 1998; USGS 2004-captures
Tadarida brasiliensis	Brazilian free-tailed bat	Present	Bogan et al. 1998; USGS 2004-sightings
Nyctinomops macrotis	big free-tailed bat	Present	Bogan et al. 1998; USGS 2003, 2004-audible calls
Ochotona princeps	American pika	Present	USGS 2003, 2004-sightings
Sylvilagus audubonii	desert cottontail	Present	USGS 2003, 2004-sightings
Sylvilagus nuttallii	mountain cottontail	Present	USGS 2003, 2004-voucher
Lepus californicus	black-tailed jackrabbit	Present	Guthrie and Large 1980
Neotamias minimus	least chipmunk	Present	USGS 2003, 2004-voucher
Neotamias quadrivittatus	Colorado chipmunk	Present	USGS 2003, 2004-voucher

TABLE 4. Continued BAND

Scientific Name	Common Name	Park Status	Reference/Observation
Spermophilus lateralis	golden-mantled ground squirrel	Present	USGS 2003, 2004-captures
Spermophilus variegatus	rock squirrel	Present	USGS 2003, 2004-voucher
Cynomys gunnisoni	Gunnison's prairie dog	Unconfirmed	
Sciurus aberti	Abert's squirrel	Present	USGS 2003, 2004-sightings
Tamiasciurus hudsonicus	red squirrel	Present	USGS 2003, 2004-sightings
Thomomys bottae	Botta's pocket gopher	Present	USGS 2003, 2004-voucher
Thomomys talpoides	northern pocket gopher	Present	USGS 2003, 2004-voucher
Perognathus flavus	silky pocket mouse	Present	USGS 2003, 2004-voucher
Chaetodipus intermedius	rock pocket mouse	Present	USGS 2003, 2004-voucher
Castor canadensis	American beaver	Present	USGS 2003-diagnostic sign
Reithrodontomys megalotis	western harvest mouse	Present	Guthrie and Large 1980
Peromyscus boylii	brush mouse	Present	USGS 2003-voucher
Peromyscus leucopus	white-footed mouse	Present	USGS 2003-voucher
Peromyscus maniculatus	deer mouse	Present	USGS 2003, 2004-voucher
Peromyscus nasutus	northern rock mouse	Present	USGS 2003, 2004-voucher
Peromyscus truei	piñon mouse	Present	USGS 2003, 2004-voucher
Neotoma albigula	western white-throated woodrat	Present	USGS 2003, 2004-voucher
Neotoma cinerea	bushy-tailed woodrat	Present	USGS 2003, 2004-voucher
Neotoma mexicana	Mexican woodrat	Present	USGS 2003, 2004-voucher
Clethrionomys gapperi	southern red-backed vole	Present	USGS 2003, 2004-voucher
Microtus longicaudus	long-tailed vole	Present	USGS 2003, 2004-voucher
Microtus montanus	montane vole	Present	USGS 2003, 2004-voucher
Ondatra zibethicus	common muskrat	Present	Guthrie and Large 1980
Zapus hudsonius	meadow jumping mouse	Probably Present	Swickard et al. 1971
Erethizon dorsatum	North American porcupine	Present	Guthrie and Large 1980
Canis latrans	coyote	Present	USGS 2003, 2004-sightings
Canis lupus	gray wolf	Unconfirmed	Extirpated
Vulpes vulpes	red fox	Probably Present	Guthrie and Large 1980

TABLE 4. Continued BAND

Scientific Name	Common Name	Park Status	Reference/Observation
Urocyon cinereoargenteus	common gray fox	Present	USGS 2003, 2004-sightings
Ursus americanus	American black bear	Present	USGS 2003-tracks and scat
Ursus arctos	grizzly bear	Unconfirmed	Extirpated
Bassariscus astutus	ringtail	Present	USGS 2003-scat; NPS-photo
Procyon lotor	northern raccoon	Present	USGS 2003, 2004-sightings
Mustela erminea	ermine	Present	Guthrie and Large 1980
Mustela frenata	long-tailed weasel	Present	USGS 2003-capture just off park
Lontra canadensis	northern river otter	Unconfirmed	Extirpated
Taxidea taxus	American badger	Present	Guthrie and Large 1980
Spilogale gracilis	western spotted skunk	Probably Present	nearest record in Bernalillo Co., Findley et al. 1975
Mephitis mephitis	striped skunk	Present	USGS 2003-scat
Puma concolor	mountain lion	Present	USGS 2003-scat, NPS sightings
Lynx rufus	bobcat	Present	USGS 2003-tracks and scat
Equus asinus	feral ass	Historic	Non-native, presumed extirpated
Cervus elaphus	elk	Present	USGS 2003, 2004-sightings
Odocoileus hemionus	mule deer	Present	USGS 2003, 2004-sightings
Ovis canadensis	bighorn sheep	Historic	Findley et al. 1975; MSB

TABLE 5. Master list of mammals of Chaco Culture National Historical Park (CHCU), including those with uncertain status. Observations of species during our inventory are listed in the "Reference/Observation" column as USGS. Species with previously published voucher material are also shown in the "Reference/Observation" column with museum acronyms. All museum acronyms can be found in Findley et al. 1975, where all previously published voucher specimens are reported.

Scientific Name	Common Name	Park Status	Reference/Observation
Notiosorex crawfordi	Crawford's desert shrew	Present	sighting E. W. Valdez, pers. comm.
Myotis californicus	California myotis	Present	Valdez et al 2002a
Myotis ciliolabrum	western small-footed myotis	Present	Valdez et al 2002a
Myotis evotis	long-eared myotis	Present	Valdez et al 2002a
Myotis thysanodes	fringed myotis	Present	Valdez et al 2002a
Myotis volans	long-legged myotis	Present	Valdez et al 2002a
Myotis yumanensis	Yuma myotis	Present	Valdez et al 2002a
Lasiurus cinereus	hoary bat	Present	Valdez et al 2002a
Lasionycteris noctivagans	silver-haired bat	Present	Valdez et al 2002a
Pipistrellus hesperus	western pipistrelle	Present	Valdez et al 2002a
Eptesicus fuscus	big brown bat	Present	Valdez et al 2002a
Euderma maculatum	spotted bat	Present	Valdez et al 2002a; USGS 2004-sighting
Corynorhinus townsendii	Townsend's big-eared bat	Present	Valdez et al 2002a
Antrozous pallidus	pallid bat	Present	Valdez et al 2002a; USGS 2004-capture; MSB
Tadarida brasiliensis	Brazilian free-tailed bat	Present	Valdez et al 2002a
Nyctinomops macrotis	big free-tailed bat	Present	USGS 2003, 2004 audible calls heard
Sylvilagus audubonii	desert cottontail	Present	USGS 2003, 2004-sighting; AMNH
Sylvilagus floridanus	eastern cottontail	Unconfirmed	nearest record from Mt Taylor; Findley et al. 1975
Lepus californicus	black-tailed jackrabbit	Present	USGS 2003-sighting
Neotamias quadrivittatus	Colorado chipmunk	Present	USGS 2003, 2004-voucher; MVZ
Ammospermophilus leucurus	white-tailed antelope squirrel	Present	USGS 2003, 2004-voucher; MSB; UUM; AMNH
Spermophilus spilosoma	spotted ground squirrel	Present	MSB
Spermophilus variegatus	rock squirrel	Present	USGS 2004-sighting
Cynomys gunnisoni	Gunnison's prairie dog	Present	USGS 2003, 2004-sighting; MSB
Thomomys bottae	Botta's pocket gopher	Present	USGS 2003, 2004-voucher

TABLE 5. Continued CHCU

Scientific Name	Common Name	Park Status	Reference/Observation
Perognathus flavus	silky pocket mouse	Present	USGS 2003, 2004-voucher; MSB; MVZ
Perognathus flavescens	plains pocket mouse	Present	USGS 2003, 2004-voucher; MSB
Dipodomys ordii	Ord's kangaroo rat	Present	USGS 2003, 2004-voucher; MSB; MVZ; AMNH
Dipodomys spectabilis	banner-tailed kangaroo rat	Present	USGS 2003, 2004-voucher; MVZ; USNM
Castor canadensis	American beaver	Historic	Pueblo Bonito-USNM
Reithrodontomys megalotis	western harvest mouse	Present	USGS 2003, 2004-voucher; MVZ;
Peromyscus boylii	brush mouse	Present	USGS 2003, 2004-voucher
Peromyscus crinitus	canyon mouse	Present	USGS 2003, 2004-voucher; MSB; MHP; USNM
Peromyscus maniculatus	deer mouse	Present	USGS 2003, 2004-voucher; MSB; MVZ
Peromyscus truei	piñon mouse	Present	USGS 2003, 2004-voucher; MVZ; USNM
Onychomys leucogaster	northern grasshopper mouse	Present	USGS 2003, 2004-voucher; MSB; MVZ; USNM
Neotoma albigula	western white-throated woodrat	Present	USGS 2003, 2004-voucher
Neotoma cinerea	bushy-tailed woodrat	Present	USGS 2004-voucher; MSB; USNM
Neotoma stephensi	Stephen's woodrat	Present	USGS 2003, 2004-voucher; MSB
Erethizon dorsatum	North American porcupine	Present	USGS 2003, 2004-scat and quills; USNM
Canis latrans	coyote	Present	USGS 2003, 2004-sightings; USNM; AMNH
Canis lupus	gray wolf	Unconfirmed	Extirpated
Vulpes macrotis	kit fox	Present	USGS 2003-sighting
Urocyon cinereoargenteus	common gray fox	Present	USGS 2003-tracks and scat
Ursus americanus	American black bear	Present	NPS documentation
Bassariscus astutus	ringtail	Probably Present	nearest record in Valencia Co., Findley et al. 1975
Procyon lotor	northern raccoon	Probably Present	nearest record in San Juan Co., Findley et al. 1975
Mustela frenata	long-tailed weasel	Unconfirmed	
Mustela nigripes	black-footed ferret	Unconfirmed	Extirpated
Taxidea taxus	American badger	Present	USGS 2003-burrow; USNM
Spilogale gracilis	western spotted skunk	Present	MSB
Mephitis mephitis	striped skunk	Present	MSB

TABLE 5. Continued CHCU

Scientific Name	Common Name	Park Status	Reference/Observation
Puma concolor	mountain lion	Present	USGS 2003-scat
Lynx rufus	bobcat	Present	USGS 2003-voucher; MSB
Cervus elaphus	elk	Present	USGS 2003, 2004-sightings
Odocoileus hemionus	mule deer	Present	USGS 2003, 2004-sightings
Antilocapra americana	pronghorn	Possibly Present	Observed along NM Hwy 550
Capra hircus	goat	Present	USGS 2003-horn sheath; exotic

TABLE 6. Master list of mammals of El Malpais National Monument (ELMA), including those with uncertain status. Observations of species during our inventory are listed in the "Reference/Observation" column as USGS. We considered a number of localities reported by Hooper (1941) to be part of ELMA even though some are just outside park boundaries.*

Scientific Name	Common Name	Park Status	Reference/Observation
Sorex monticolus	montane shrew	Unconfirmed	
Notiosorex crawfordi	Crawford's desert shrew	Probably Present	nearest record in Valencia Co., Findley et al. 1975
Myotis californicus	California myotis	Present	USGS 2004
Myotis ciliolabrum	western small-footed myotis	Present	Hooper 1941; USGS 2004-voucher
Myotis evotis	long-eared myotis	Present	Hooper 1941; USGS 2003, 2004
Myotis thysanodes	fringed myotis	Present	Hooper 1941; USGS 2003, 2004
Myotis volans	long-legged myotis	Present	Hooper 1941; USGS 2003
Lasiurus cinereus	hoary bat	Present	USGS 2003
Lasionycteris noctivagans	silver-haired bat	Present	Hooper 1941; USGS 2004
Pipistrellus hesperus	western pipistrelle	Present	Valdez et al 2002b-audible just off park
Eptesicus fuscus	big brown bat	Present	Hooper 1941; USGS 2003, 2004
Euderma maculatum	spotted bat	Present	USGS 2004-audible
Corynorhinus townsendii	Townsend's big-eared bat	Present	USGS 2003, 2004
Antrozous pallidus	pallid bat	Present	USGS 2004
Tadarida brasiliensis	Brazilian free-tailed bat	Present	USGS 2004
Nyctinomops macrotis	big free-tailed bat	Present	Valdez et al 2002b-audible just off park
Sylvilagus audubonii	desert cottontail	Present	Hooper 1941; USGS 2003, 2004-sighting
Sylvilagus floridanus	eastern cottontail	Unconfirmed	see Hooper 1941 reported as *S. nuttallii*
Lepus californicus	black-tailed jackrabbit	Present	Hooper 1941; USGS 2003; 2004-sighting
Neotamias dorsalis	cliff chipmunk	Present	Hooper 1941; USGS 2003; 2004-voucher
Neotamias quadrivittatus	Colorado Chipmunk	Present	USGS 2003-voucher
Spermophilus spilosoma	spotted ground squirrel	Present	USGS 2004-sighting just off park
Spermophilus variegatus	rock squirrel	Present	Hooper 1941; USGS 2003, 2004-sightings
Cynomys gunnisoni	Gunnison's prairie dog	Present	Hooper 1941; USGS 2003, 2004-sightings
Sciurus aberti	Abert's squirrel	Present	Hooper 1941; NPS observation
Tamiasciurus hudsonicus	red squirrel	Unconfirmed	Extirpated from region? see Hooper 1941
Thomomys bottae	Botta's pocket gopher	Present	Hooper 1941; USGS 2003-voucher

TABLE 6. Continued ELMA

Scientific Name	Common Name	Park Status	Reference/Observation
Perognathus flavus	silky pocket mouse	Present	Hooper 1941; USGS 2003, 2004-voucher
Perognathus flavescens	plains pocket mouse	Present	USGS 2003-voucher
Dipodomys ordii	Ord's kangaroo rat	Present	Hooper 1941; USGS 2003-voucher
Dipodomys spectabilis	banner-tailed kangaroo rat	Present	USGS 2003-voucher
Reithrodontomys megalotis	western harvest mouse	Present	USGS 2003, 2004-voucher
Peromyscus maniculatus	deer mouse	Present	Hooper 1941; USGS 2003, 2004-voucher
Peromyscus leucopus	white-footed mouse	Unconfirmed	
Peromyscus boylii	brush mouse	Present	Hooper 1941; USGS 2003, 2004-voucher
Peromyscus truei	piñon mouse	Present	USGS 2003, 2004-voucher
Peromyscus nasutus	northern rock mouse	Present	Hooper 1941; USGS 2003, 2004-voucher
Onychomys leucogaster	northern grasshopper mouse	Present	Hooper 1941; USGS 2003, 2004-voucher
Sigmodon fulviventer	tawny-bellied cotton rat	Present	USGS 2003, 2004-voucher
Neotoma albigula	western white-throated woodrat	Present	Hooper 1941; USGS 2003, 2004-voucher
Neotoma micropus	southern plains woodrat	Unconfirmed	see Hooper 1941
Neotoma mexicana	Mexican woodrat	Present	Hooper 1941; USGS 2003, 2004-voucher
Neotoma stephensi	Stephen's woodrat	Probably Present	see Hooper 1941; Findley et al. 1975
Microtus pennsylvanicus	meadow vole	Unconfirmed	Possibly extinct in area (Frey 2004)
Microtus mogollonensis	Mogollon vole	Present	USGS 2003, 2004-voucher
Mus musculus	house mouse	Probably Present	
Erethizon dorsatum	North American porcupine	Present	Hooper 1941, USGS 2003-scat
Canis latrans	coyote	Present	Hooper 1941; USGS 2003, 2004-sighting
Canis lupus	gray wolf	Unconfirmed	Extirpated; see Hooper 1941
Vulpes macrotis	kit fox	Present	USGS 2003-tracks and scat
Vulpes vulpes	red fox	Present	USGS 2003-tracks
Urocyon cinereoargenteus	common gray fox	Present	Hooper 1941; USGS 2003- tracks
Ursus americanus	American black bear	Present	USGS 2003-tracks
Ursus arctos	grizzly bear	Unconfirmed	Extirpated
Bassariscus astutus	ringtail	Present	Hooper 1941; USGS 2004-sighting
Procyon lotor	northern raccoon	Probably Present	nearest record from Mt. Taylor, Hooper 1941

TABLE 6. Continued ELMA

Scientific Name	Common Name	Park Status	Reference/Observation
Mustela frenata	long-tailed weasel	Present	Hooper 1941; USGS 2003-sighting off park
Mustela nigripes	black-footed ferret	Unconfirmed	Extirpated; Hooper 1941 reports in area
Taxidea taxus	American badger	Probably Present	see Hooper 1941
Spilogale gracilis	western spotted skunk	Probably Present	nearest record is Thoreau, Findley et al. 1975
Mephitis mephitis	striped skunk	Present	Hooper 1941
Conepatus leuconotus	white-backed hog-nosed skunk	Present	Hooper 1941; extirpated since Hooper?
Puma concolor	mountain lion	Present	USGS 2003-tracks and scat; NPS observation
Lynx rufus	bobcat	Present	Hooper 1941; USGS 2003-tracks and scat
Pecari tajacu	collared peccary	Present	Albert et al. 2004-voucher
Cervus elaphus	elk	Present	USGS 2003, 2004-sightings
Odocoileus hemionus	mule deer	Present	Hooper 1941; USGS 2003, 2004-sightings
Antilocapra americana	pronghorn	Present	USGS 2003-sighting
Ovis canadensis	bighorn sheep	Historic	Extirpated; Hooper 1941; Findley et al. 1975

*We accept several localities described in Hooper (1941) as representing ELMA. Some of these localities are either surrounded by park property or within a mile of park property. The localities include near Flagpole Crater, north side Flagpole Crater, Porter's Ranch, nine miles south-southeast of Grants, eleven miles south-southeast of Grants, and Point of Malpais (Hooper 1941).

TABLE 7. Levels of documentation (numbers and percentages) of mammals at Bandelier National Monument prior to and following inventories in 2003 and 2004. Species previously documented from the park are based on park reports by Bogan et al. (1998) for bats and Guthrie and Large (1980) for all other mammals. Total species possible include extirpated and unconfirmed species, which we do not considered part of the current mammalian fauna. Total species likely are those species with confirmed documentation and those reasonably suspected to occur in the park (i.e., probably present). Percentages are based on "total species likely."

Order	Total species possible	Total species likely	Previously documented species	Number of species present			Percent of likely species		Percent originally known	Final % of likely species
				2003	2004	Final	2003	2004		
Insectivora	6	6	1	1	2	2	17%	33%	17%	33%
Chiroptera	15	15	15	15	15	15	100%	100%	100%	100%
Lagomorpha	4	4	3	4	4	4	100%	100%	75%	100%
Rodentia	27	26	24	25	25	25	96%	96%	92%	96%
Carnivora	16	13	11	11	11	11	85%	85%	85%	85%
Artiodactyla	4	2	2	2	2	2	100%	100%	100%	100%
Total	72	66	56	58	59	59	88%	89%	85%	89%

TABLE 8. Levels of documentation (numbers and percentages) of mammals at Chaco Culture National Historical Park prior to and following inventories in 2003 and 2004. Species previously documented from the park are based on Valdez et al. (2002a) for bats, Cully (1981) for other mammals, and Findley et al. (1975) for specimens housed at the Museum of Southwestern Biology. Total species possible include extirpated and unconfirmed species, which we do not considered part of the current mammalian fauna. Total species likely are those species with confirmed documentation and those reasonably suspected to occur in the park (i.e., probably present). Percentages are based on "total species likely."

Order	Total species possible	Total species likely	Previously documented species	Number of species present			Percent of likely species		Percent originally known	Final % of likely species
				2003	2004	Final	2003	2004		
Insectivora	1	1	0	1	1	1	100%	100%	0%	100%
Chiroptera	15	15	14	15	15	15	100%	100%	93%	100%
Lagomorpha	3	2	2	2	2	2	100%	100%	100%	100%
Rodentia	21	20	18	20	20	20	100%	100%	90%	100%
Carnivora	14	11	7	9	9	9	81%	81%	63%	81%
Artiodactyla	4	4	1	3	3	3	75%	75%	25%	75%
Total	58	53	42	50	50	50	94%	94%	79%	94%

TABLE 9. Levels of documentation (numbers and percentages) of mammals at El Malpais National Monument prior to and following inventories in 2003 and 2004. Species previously documented from the park are based on Valdez et al. (2002b) for bats, Hooper (1941) for other mammals, and Albert et al (2004) for peccary. Total species possible include extirpated and unconfirmed species, which we do not consider part of the current mammalian fauna. Total species likely are those species with confirmed documentation and those reasonably suspected to occur in the park (i.e., probably present). Percentages are based on "total species likely."

Order	Total species possible	Total species likely	Previously documented species	Number of species present			Percent of likely species		Percent originally known	Final % of likely species
				2003	2004	Final	2003	2004		
Insectivora	2	1	0	0	0	0	0%	0%	0%	0%
Chiroptera	14	14	14	14	14	14	100%	100%	100%	100%
Lagomorpha	3	2	2	2	2	2	100%	100%	100%	100%
Rodentia	28	24	14	21	22	22	88%	92%	58%	92%
Carnivora	17	14	7	11	11	11	79%	79%	50%	79%
Artiodactyla	5	4	2	4	4	4	100%	100%	50%	100%
Total	69	59	39	52	53	53	88%	90%	66%	90%

TABLE 10. List of mammalian species present at Bandelier National Monument (BAND) and selected attributes for use in NP-SPECIES database. See Table 4 for full list of scientific, common names, and reference/observation information. Please note that abundance designations refer to abundances of species in appropriate habitats in which they usually occur. Because of small home ranges for shrews and rodents, we consider all of these species documented in park as breeders in the park.

Scientific Name	Park Status	Abundance	Residency	Nativity
Sorex cinereus	Probably Present	Unknown	Unknown	Native
Sorex merriami	Probably Present	Unknown	Unknown	Native
Sorex monticolus	Present	Uncommon	Breeder	Native
Sorex nanus	Probably Present	Unknown	Unknown	Native
Sorex palustris	Present	Rare	Breeder	Native
Sorex preblei	Probably Present	Unknown	Unknown	Native
Myotis californicus	Present	Uncommon	Breeder	Native
Myotis ciliolabrum	Present	Common	Breeder	Native
Myotis evotis	Present	Common	Breeder	Native
Myotis thysanodes	Present	Common	Breeder	Native
Myotis volans	Present	Common	Breeder	Native
Myotis yumanensis	Present	Uncommon	Breeder	Native
Lasiurus cinereus	Present	Common	Resident	Native
Lasionycteris noctivagans	Present	Abundant	Resident	Native
Pipistrellus hesperus	Present	Uncommon	Breeder	Native
Eptesicus fuscus	Present	Uncommon	Breeder	Native
Euderma maculatum	Present	Uncommon	Breeder	Native
Corynorhinus townsendii	Present	Uncommon	Breeder	Native
Antrozous pallidus	Present	Common	Breeder	Native
Tadarida brasiliensis	Present	Common	Breeder	Native
Nyctinomops macrotis	Present	Uncommon	Breeder	Native
Ochotona princeps	Present	Uncommon	Breeder	Native
Sylvilagus audubonii	Present	Common	Breeder	Native
Sylvilagus nuttallii	Present	Common	Breeder	Native
Lepus californicus	Present	Rare	Breeder	Native
Neotamias minimus	Present	Abundant	Breeder	Native

TABLE 10. Continued BAND

Scientific Name	Park Status	Abundance	Residency	Nativity
Neotamias quadrivittatus	Present	Common	Breeder	Native
Spermophilus lateralis	Present	Common	Breeder	Native
Spermophilus variegatus	Present	Uncommon	Breeder	Native
Cynomys gunnisoni	Unconfirmed			Native
Sciurus aberti	Present	Uncommon	Breeder	Native
Tamiasciurus hudsonicus	Present	Common	Breeder	Native
Thomomys bottae	Present	Abundant	Breeder	Native
Thomomys talpoides	Present	Common	Breeder	Native
Perognathus flavus	Present	Rare	Breeder	Native
Chaetodipus intermedius	Present	Uncommon	Breeder	Native
Castor canadensis	Present	Uncommon	Breeder	Native
Reithrodontomys megalotis	Present	Rare	Breeder	Native
Peromyscus boylii	Present	Uncommon	Breeder	Native
Peromyscus leucopus	Present	Uncommon	Breeder	Native
Peromyscus maniculatus	Present	Abundant	Breeder	Native
Peromyscus nasutus	Present	Common	Breeder	Native
Peromyscus truei	Present	Common	Breeder	Native
Neotoma albigula	Present	Uncommon	Breeder	Native
Neotoma cinerea	Present	Uncommon	Breeder	Native
Neotoma mexicana	Present	Common	Breeder	Native
Clethrionomys gapperi	Present	Uncommon	Breeder	Native
Microtus longicaudus	Present	Common	Breeder	Native
Microtus montanus	Present	Common	Breeder	Native
Ondatra zibethicus	Present	Uncommon	Breeder	Native
Zapus hudsonius	Probably Present	Unknown	Unknown	Native
Erethizon dorsatum	Present	Uncommon	Breeder	Native
Canis latrans	Present	Common	Breeder	Native
Canis lupus	Unconfirmed			Native
Vulpes vulpes	Probably Present	Unknown	Unknown	Native

TABLE 10. Continued BAND

Scientific Name	Park Status	Abundance	Residency	Nativity
Urocyon cinereoargenteus	Present	Uncommon	Breeder	Native
Ursus americanus	Present	Common	Breeder	Native
Ursus arctos	Unconfirmed			Native
Bassariscus astutus	Present	Uncommon	Breeder	Native
Procyon lotor	Present	Common	Breeder	Native
Mustela erminea	Present	Uncommon	Breeder	Native
Mustela frenata	Present	Uncommon	Breeder	Native
Lontra canadensis	Unconfirmed			Native
Taxidea taxus	Present	Rare	Resident	Native
Spilogale gracilis	Probably Present	Unknown	Unknown	Native
Mephitis mephitis	Present	Uncommon	Breeder	Native
Puma concolor	Present	Uncommon	Breeder	Native
Lynx rufus	Present	Common	Breeder	Native
Equus asinus	Historic			Non-native
Cervus elaphus	Present	Abundant	Breeder	Native
Odocoileus hemionus	Present	Common	Breeder	Native
Ovis canadensis	Historic			Native

TABLE 11. List of mammalian species present at Chaco Culture National Historical Park (CHCU) and selected attributes for use in NP-SPECIES database. See Table 5 for full list of scientific, common names, and reference/observation information. Please note that abundance designations refer to abundances of species in appropriate habitats in which they usually occur. Because of small home ranges for shrews and rodents, we consider all of these species documented in park as breeders in the park.

Scientific Name	Park Status	Abundance	Residency	Nativity
Notiosorex crawfordi	Present	Rare	Breeder	Native
Myotis californicus	Present	Common	Breeder	Native
Myotis ciliolabrum	Present	Common	Resident	Native
Myotis evotis	Present	Uncommon	Resident	Native
Myotis thysanodes	Present	Common	Breeder	Native
Myotis volans	Present	Uncommon	Breeder	Native
Myotis yumanensis	Present	Uncommon	Resident	Native
Lasiurus cinereus	Present	Rare	Resident	Native
Lasionycteris noctivagans	Present	Uncommon	Resident	Native
Pipistrellus hesperus	Present	Common	Breeder	Native
Eptesicus fuscus	Present	Rare	Resident	Native
Euderma maculatum	Present	Rare	Resident	Native
Corynorhinus townsendii	Present	Uncommon	Breeder	Native
Antrozous pallidus	Present	Common	Breeder	Native
Tadarida brasiliensis	Present	Uncommon	Resident	Native
Nyctinomops macrotis	Present	Rare	Resident	Native
Sylvilagus audubonii	Present	Common	Breeder	Native
Sylvilagus floridanus	Unconfirmed			Native
Lepus californicus	Present	Common	Breeder	Native
Neotamias quadrivittatus	Present	Uncommon	Breeder	Native
Ammospermophilus leucurus	Present	Uncommon	Breeder	Native
Spermophilus spilosoma	Present	Rare	Breeder	Native
Spermophilus variegatus	Present	Rare	Breeder	Native
Cynomys gunnisoni	Present	Uncommon	Breeder	Native
Thomomys bottae	Present	Common	Breeder	Native

TABLE 11. Continued CHCU

Scientific Name	Park Status	Abundance	Residency	Nativity
Perognathus flavus	Present	Common	Breeder	Native
Perognathus flavescens	Present	Uncommon	Breeder	Native
Dipodomys ordii	Present	Uncommon	Breeder	Native
Dipodomys spectabilis	Present	Uncommon	Breeder	Native
Castor canadensis	Historic			Native
Reithrodontomys megalotis	Present	Uncommon	Breeder	Native
Peromyscus boylii	Present	Uncommon	Breeder	Native
Peromyscus crinitus	Present	Common	Breeder	Native
Peromyscus maniculatus	Present	Abundant	Breeder	Native
Peromyscus truei	Present	Common	Breeder	Native
Onychomys leucogaster	Present	Common	Breeder	Native
Neotoma albigula	Present	Common	Breeder	Native
Neotoma cinerea	Present	Uncommon	Breeder	Native
Neotoma stephensi	Present	Uncommon	Breeder	Native
Erethizon dorsatum	Present	Uncommon	Breeder	Native
Canis latrans	Present	Common	Breeder	Native
Canis lupus	Unconfirmed			Native
Vulpes macrotis	Present	Uncommon	Breeder	Native
Urocyon cinereoargenteus	Present	Uncommon	Breeder	Native
Ursus americanus	Present	Rare	Vagrant	Native
Bassariscus astutus	Probably Present	Unknown	Unknown	Native
Procyon lotor	Probably Present	Unknown	Unknown	Native
Mustela frenata	Unconfirmed			Native
Mustela nigripes	Unconfirmed			Native
Taxidea taxus	Present	Unknown	Resident	Native
Spilogale gracilis	Present	Unknown	Unknown	Native
Mephitis mephitis	Present	Unknown	Unknown	Native
Puma concolor	Present	Uncommon	Unknown	Native

TABLE 11. Continued CHCU

Scientific Name	Park Status	Abundance	Residency	Nativity
Odocoileus hemionus	Present	Common	Breeder	Native
Antilocapra americana	Unconfirmed			Native
Capra hircus	Present	Rare	Vagrant	Non-native

TABLE 12. List of mammalian species present at El Malpais National Monument (ELMA) and selected attributes for use in NP-SPECIES database. See Table 6 for full list of scientific, common names, and reference/observation information. Please note that abundance designations refer to abundances of species in appropriate habitats in which they usually occur. Because of small home ranges for shrews and rodents, we consider all of these species documented in park as breeders in the park.

Scientific Name	Park Status	Abundance	Residency	Nativity
Sorex monticolus	Unconfirmed			Native
Notiosorex crawfordi	Probably Present	Unknown	Unknown	Native
Myotis californicus	Present	Uncommon	Breeder	Native
Myotis ciliolabrum	Present	Common	Breeder	Native
Myotis evotis	Present	Common	Breeder	Native
Myotis thysanodes	Present	Common	Breeder	Native
Myotis volans	Present	Uncommon	Resident	Native
Lasiurus cinereus	Present	Rare	Resident	Native
Lasionycteris noctivagans	Present	Common	Resident	Native
Pipistrellus hesperus	Present	Unknown	Resident	Native
Eptesicus fuscus	Present	Common	Breeder	Native
Euderma maculatum	Present	Rare	Resident	Native
Corynorhinus townsendii	Present	Uncommon	Breeder	Native
Antrozous pallidus	Present	Uncommon	Breeder	Native
Tadarida brasiliensis	Present	Common	Resident	Native
Nyctinomops macrotis	Present	Unknown	Resident	Native
Sylvilagus audubonii	Present	Uncommon	Breeder	Native
Sylvilagus floridanus	Unconfirmed			Native
Lepus californicus	Present	Uncommon	Breeder	Native
Neotamias dorsalis	Present	Uncommon	Breeder	Native
Neotamias quadrivittatus	Present	Rare	Breeder	Native
Spermophilus spilosoma	Present	Rare	Breeder	Native
Spermophilus variegatus	Present	Uncommon	Breeder	Native
Cynomys gunnisoni	Present	Common	Breeder	Native
Sciurus aberti	Present	Rare	Unknown	Native
Tamiasciurus hudsonicus	Unconfirmed			Native

TABLE 12. Continued ELMA

Scientific Name	Park Status	Abundance	Residency	Nativity
Thomomys bottae	Present	Common	Breeder	Native
Perognathus flavus	Present	Common	Breeder	Native
Perognathus flavescens	Present	Uncommon	Breeder	Native
Dipodomys ordii	Present	Common	Breeder	Native
Dipodomys spectabilis	Present	Uncommon	Breeder	Native
Reithrodontomys megalotis	Present	Common	Breeder	Native
Peromyscus maniculatus	Present	Abundant	Breeder	Native
Peromyscus leucopus	Unconfirmed			Native
Peromyscus boylii	Present	Uncommon	Breeder	Native
Peromyscus truei	Present	Common	Breeder	Native
Peromyscus nasutus	Present	Common	Breeder	Native
Onychomys leucogaster	Present	Uncommon	Breeder	Native
Sigmodon fulviventer	Present	Uncommon	Breeder	Native
Neotoma albigula	Present	Common	Breeder	Native
Neotoma micropus	Unconfirmed			Native
Neotoma mexicana	Present	Uncommon	Breeder	Native
Neotoma stephensi	Probably Present	Unknown	Unknown	Native
Microtus pennsylvanicus	Unconfirmed			Native
Microtus mogollonensis	Present	Uncommon	Breeder	Native
Mus musculus	Probably Present	Unknown	Unknown	Non-native
Erethizon dorsatum	Present	Uncommon	Breeder	Native
Canis latrans	Present	Common	Breeder	Native
Canis lupus	Unconfirmed			Native
Vulpes macrotis	Present	Uncommon	Resident	Native
Vulpes vulpes	Present	Uncommon	Unknown	Native
Urocyon cinereoargenteus	Present	Uncommon	Breeder	Native
Ursus americanus	Present	Uncommon	Unknown	Native
Ursus arctos	Unconfirmed			Native

TABLE 12. Continued ELMA

Scientific Name	Park Status	Abundance	Residency	Nativity
Bassariscus astutus	Present	Uncommon	Breeder	Native
Procyon lotor	Probably Present	Unknown	Unknown	Native
Mustela frenata	Present	Uncommon	Breeder	Native
Mustela nigripes	Unconfirmed			Native
Taxidea taxus	Probably Present	Unknown	Unknown	Native
Spilogale gracilis	Probably Present	Unknown	Unknown	Native
Mephitis mephitis	Present	Rare	Unknown	Native
Conepatus leuconotus	Present	Unknown	Unknown	Native
Puma concolor	Present	Uncommon	Resident	Native
Lynx rufus	Present	Uncommon	Breeder	Native
Pecari tajacu	Present	Unknown	Unknown	Native
Cervus elaphus	Present	Uncommon	Breeder	Native
Odocoileus hemionus	Present	Uncommon	Breeder	Native
Antilocapra americana	Present	Uncommon	Unknown	Native
Ovis canadensis	Historic			Native

APPENDIX 1. List of personnel that assisted with mammalian inventories at BAND, CHCU, and ELMA during 2003 and 2004. All personnel listed were employees or contractors of U.S. Geological Survey.

Name	Title	Telephone No.	City
Michael A. Bogan	PI, Wildlife Research Biologist, USGS	505-277-8171	Albuquerque, NM
Cindy Ramotnik	Collection Manager, USGS	505-277-5369	Albuquerque, NM
Keith Geluso	Wildlife Biologist, USGS	505-346-2870	Albuquerque, NM
Justin Hoffman	Graduate Student, University of Nebraska	916-294-9705	Lincoln, NE
Jeff Mink	Instructor, Albuquerque, TVI	254-214-5317	Albuquerque, NM
Larisa Harding	Graduate Student, University of New Mexico	505-277-9173	Albuquerque, NM
Rusty Ligon	Student, Pomona College	909-607-5760	Claremont, CA
Jeremy White	Graduate Student, Auburn University	334-884-9230	Auburn, AL
Vikki Ashe	Graduate Student, Auburn University	334-884-9259	Auburn, AL